Pesticide Use Reduction Strategies in Europe

Six case studies

PAN Europe

Pesticide Action Network Europe

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Executive Summary

One of the concepts most consistently overlooked within the European Union agricultural policy forum is that of 'pesticide use reduction'. As a result of lobbying from the agrochemicals industry, discussion has instead tended to focus on 'risk reduction'. In addition, there is now a widespread misconception that pesticides remaining on the EU market are harmless, and that the biggest threats posed by agrochemicals in Europe relate to illegal imports of unauthorised pesticides.

The chronic failure of EU agricultural policy makers to address Europe's escalating reliance on agrochemical inputs underlies a long term trend within which pesticide consumption continues to increase unchecked. Negative impacts of intensive pesticide use have grown more evident: there is widespread contamination of food and water resources, biodiversity is in decline, and human health continues to be negatively affected.

Despite Brussels' failure to set policies aimed at reducing the extent of pesticide consumption, a selection of national Governments, farmers' associations, co-operatives, NGOs and retailers throughout Europe have pressed ahead in implementing strategies for reversing reliance on agrochemical inputs. Targets for pesticide use reduction have been adopted in Denmark, Sweden, Netherlands, France and Germany. In several states farmers have joined together to reduce pesticide usage and to market food produce grown under reduced pesticide protocols. Elsewhere, NGOs are working both to raise greater public awareness of the problems associated with intensive pesticide usage, and engage producers in setting standards and pushing towards zero pesticides residues in food. Some major retailers are now sourcing food produce endorsed by low pesticide labels, thus providing an increased economic incentive for pesticide reduction in Europe.

This publication sets out six case studies based in countries throughout Europe in which numerous stakeholders within the food supply chain have come together to achieve concrete reductions in pesticide use. While together these initiatives cover only a small proportion of total agricultural produce grown within the EU, they provide irrefutable evidence that pesticide use reduction is not only possible within the context of mainstream agricultural production, but economically feasible within today's free market economy. In collating the information contained in this report, our aim is to provide much needed information to all those interested in strengthening sustainable methods of crop protection and agriculture production. In particular the studies provide much needed motivation to EU policy makers, and those responsible for the implementation of National Action Plans under the forthcoming Directive for the Sustainable Use of Pesticides. In addition we wish to highlight alternative agricultural developmental pathways to those Eastern European member states whose pesticide use is at present comparatively low and to demonstrate that increased agricultural production is indeed possible without adopting Western European levels of pesticide application.

The first case study is drawn from the Netherlands and offers an example of a comparatively complete policy approach because it includes the Government-led development and implementation of a set of 'Best Practices' or guidelines for all major crops, with a strong component of research, extension and training to farmers. Farmers are well organised within a practitioners' network and hold their own discussions and exchange of experiences in working groups. It also involves an environmental indicator that permits the measurement of progress and environmental impact cards aimed at helping farmers in the selection of least hazardous pesticides. Market incentives for the implementation of 'Best Practices' however, were limited until 2005 when the Dutch supermarket Laurus decided to be a front-runner and supply Integrated Crop Management products. Producers started supplying a limited range of 6 products to Laurus (apples, pears, strawberry, parsley, cabbage, iceberg lettuce) but have expanded to other fruit and vegetables since then.

The second case study, from Belgium, offers the example of a well-organised association of growers practising Integrated Production (IP) in apples and pears. The success of this example relates to the clear standards for IP set in place and the fact that farmers are supported with independent advice and training. There is a clear labelling system (Fruitnet) and a good marketing strategy, with national

supermarket Delhaize-Le-Lion selling Fruitnet produce in over 120 outlets. Consumers see the value added in IP production and are willing to pay a slightly higher price for the product, which enables farmers to strive towards continuous improvement of standards.

The third case, from Denmark, offers the example of a successful Governmental programme for pesticide use reduction started in the 1980s and now in its third phase. There is a strong environmental motivation behind the policies, and national agreement on the need for policies addressing both use and risks of pesticides. The initiative's success is based upon a combination of instruments such as clear targets and indicators, a pesticide tax, a parallel revision programme of all substances in the Danish market, buffer zones for the protection of water resources, and record keeping. Farmers are supported by an independent training and advisory system.

The fourth case study, from Switzerland, is an example of successful implementation of IP for all major crops at national level. What could be taken as a disadvantage for Swiss agriculture (small scale farms in mountainous areas) has become a trademark for success. Farmers have clear incentives to produce according to the IP guidelines, certified by IP SUISSE, in terms of higher direct subsidy payments and a higher product price. There is also a high degree of flexibility in taking up IP and an independent training and advisory service available for farmers. There is a strong environmental drive behind IP adoption and a common understanding by all the actors in the food chain that 'Made in Switzerland' stands for quality. Marketing has been extremely successful with all major retailers and food processors buying IP SUISSE certified products.

The fifth case study, which comes from Italy, exemplifies a campaign undertaken by a not-for-profit organisation and a certification scheme for conventional products complying with a set of standards including improved animal welfare, no use of genetically modified organisms (GMOs) and zero pesticide residues. There are clear guidelines for farmers joining the scheme and support from an independent advisory service. There is a clear labelling system (LAIQ) and a good marketing strategy, with consumers and retailers accepting a slightly higher price for products that comply with stricter environmental and animal welfare criteria.

The sixth case study, from the United Kingdom, provides an example of a large supermarket company deciding to be a front-runner in reducing pesticide hazards, use and impacts. The UK Co-operative Group runs a farming business, *Farmcare*, which is the largest British farmer and supplies outlets with its own label 'Grown on Co-op farms'. The Group prohibits and restricts usage of certain pesticides based on their intrinsic hazards and actively supports farmers with advice, training and research. It was the first supermarket in the UK to undertake a pesticide policy in 1999. The strategy is proving successful, with other supermarkets following since then.

While the diversity of initiatives contained within this report clearly demonstrates the absence of one universal strategy for success, PAN Europe (PAN E) believes that those engaged in the implementation of EU policy have a responsibility to consider the case studies below, and others like them, within the context of future European agricultural production, its impact on the environment, and the long term health of the general population.

In particular this report should act to inform those engaged in the implementation of the EU Framework Directive for the Sustainable Use of Pesticides, which offers a unique opportunity to introduce EU-wide policies and objectives relating to pesticide use reduction in Europe. It is vital that Member States agree a common definition of Integrated Pest Management (IPM), establish minimum requirements for pesticide use reduction at the EU level, and identify a means of providing all stakeholders within the European food supply chain with support in achieving pesticide reduction: including crop-specific guidance; advisory support for farmers; and a reliable control system. These elements should be considered as a minimum when drafting National Action Plans in the framework of the new Directive. When defining guidelines for crop specific standards of Integrated Crop Management, a set of minimum criteria should also be considered.

Introduction

Conventional farming, in the common European understanding, is associated with high-input (industrialised) agriculture focusing on high yields and productivity. Profitability in conventional farming relies on the intensification, specialisation and concentration of agricultural production. This has resulted not only in environmental problems such as pollution of water resources by nutrients and pesticides, and the loss of habitats and biodiversity, but in socio-economic problems such as the 'rural exodus'[1] and dramatically decreased producer prices.

Despite the introduction of new substances active at lower dosages, European pesticides consumption has been increasing since 1992, indicating a growing dependency on pesticides for pest control[2]. This upward trend is especially true for new Member States, where consumption of pesticides is expected to continue growing over the coming years fuelled by growing investment and marketing from the agro-chemical companies[3]. Pesticide residues in food are also in an upward trend. The latest EU coordinated results showed that 4.7% of all samples contained residues above the Maximum Residues Limits (MRLs) and 23.4% of all samples contained multiple residues[4].

The negative side-effects of conventional agriculture lead to the emergence of new concepts and policy instruments within this system, such as Good Agricultural Practice (GAP), Good Farming Practice (GFP), Cross-Compliance, Good Plant Protection Practice, Integrated Agriculture, Integrated Production (IP), Integrated Farming Systems (IFS), Integrated Crop Management (ICM) and Integrated Pest Management (IPM). For all these concepts, scientists, not-for-profit organisations, and also traders and retailers have published a large number of definitions, standards and guidelines. Some of these concepts can be used interchangeably. Some build a framework for another concept.

Integrated Agriculture, Integrated Production (IP), Integrated Farming Systems (IFS) can be used interchangeably, and represent a whole farm approach, where each individual enterprise is integrated with the others to produce benefits through their mutual interactions[5]. Integrated Crop Management (ICM) and Integrated Pest Management (IPM) are subcomponents of Integrated Farming Systems (IFS). Integrated Crop Management (ICM) in its very meaning focuses on the management of crops, which includes aspects of selection of crop varieties, crop rotation, cultivation pauses, but also mixed cropping. In tree fruit production and other crops without frequent rotation, Integrated Pest Management (IPM) is the applicable concept, focusing on the pest spectrum of the perennial crops, although several elements of ICM may also be relevant. While the terms IPM and ICM are often used interchangeably, the difference should be clear: ICM is more holistic, while IPM has a narrower focus on a pest spectrum within an individual crop. So far there are no agreed definitions of these terms at EU level, which is not helpful for policy makers.

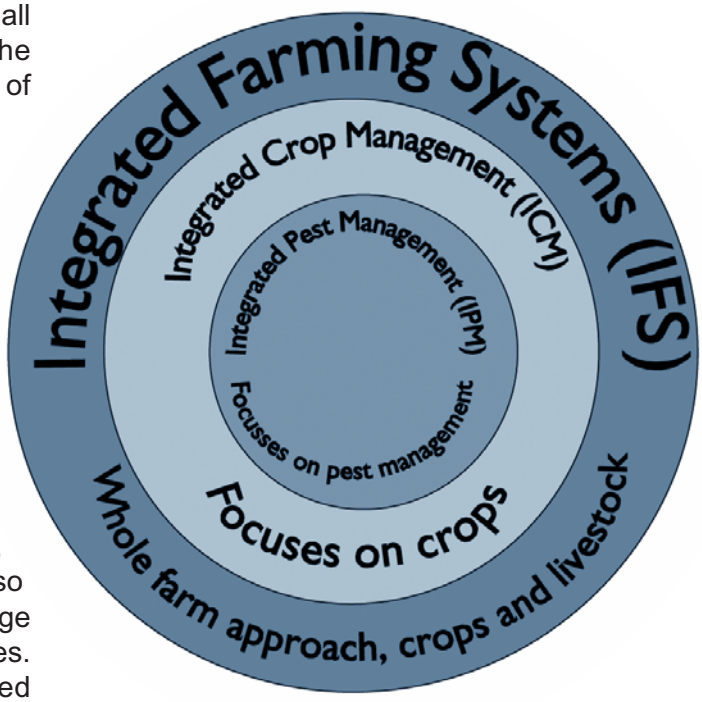


Figure 1
Components of Integrated Farming Systems.
Source: 6

The concepts of Good Agricultural Practice (GAP), Good Farming Practice and Good Plant Protection Practice (GPP) are also frequently used. These theoretically may include IFS, ICM and IPM, but at the EU level there is no common or legally binding definition for these concepts[7].

This lack of a single definition and minimum standards provides the ideal ground for the proliferation of multiple definitions in Europe, sometimes downgrading the standards and the spirit of ICM/IPM. Further confusion develops from the fact that interpretation of what IPM and ICM means can cover a wide spectrum of practices, according to the interests of the stake-holders involved. Programmes implementing IPM or ICM range from those involving only minor adjustments made within a model still based on agrochemical dependency, to those seeking a fundamental shift towards ecological practices and the redesign of farming systems. A pertinent example is 'agriculture raisonnée' in France, agreed by the agro-chemical industry, FNSEA (National Federation of Farmers Unions) and retailers. The objective 'agriculture raisonnée' lays out is productivity and despite the argument that it is better for the environment, there are no monitoring results attesting this claim. On the contrary, the system relies heavily on fertilisers and pesticides, high-energy feed and antibiotics for animal production, and selection of varieties to increase performance instead of resistance to pests and diseases. The only standards required are record keeping, use of authorised products and participation in an advisory system. There are minimum conditions required for pesticide storage, inspection of spraying equipment and waste management but if compared, for example, with the comprehensive guidelines set by IOBC (International Organisation for Biological and Integrated Control of Noxious Animals and Plants), it is clear that 'agriculture raisonnée' does not go beyond conventional farming. There are no obligations or even mention of rotation, biological diversity and resistant varieties in 'agriculture raisonnée', while in the IOBC guidelines, rotation is obligatory and must comprise at least four different crops, areas of ecological compensation to stimulate biological diversity have to cover at least 5% of the entire farm surface and resistant varieties should always be preferred. As for the selection of pesticides, the IOBC guidelines prohibit broad spectrum (non-selective), persistent, and volatile pesticides, as well as pesticides that might leach to the groundwater, while 'agriculture raisonnée' permits all authorised pesticides. Fortunately, the need for genuine pesticide use reduction and implementation of agroecological approach Integrated Crop Management in France and elsewhere has been explained in numerous experts' reports such as in the Collective Scientific Expert Report from INRA entitled "*Pesticides, agriculture and the environment: Reducing the use of pesticides and limiting their environmental impact"* published in 2005[8].

The first attempt to provide an EU wide definition of IPM was as recent as 2006. In the proposed Thematic Strategy on the Sustainable Use of Pesticides, the European Commission proposes that from 2014 onwards all farms should comply with the general principles of IPM as a minimum. These general principles shall be defined by experts from Member States in close cooperation with the European Commission and the proposed definition of IPM follows the Food and Agriculture Organisation (FAO) definition, which has been agreed by governments, private stakeholders and NGOs:

'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 forms of intervention to levels that are economically justified and reduce or minimise risks to human health and the environment. Integrated pest management emphasises the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms.'

PAN E welcomes the proposal to use the FAO definition of IPM as a first step towards a more ecologically-orientated approach to pest management and reducing current dependency on pesticides. As a second step, farmers will need detailed crop and region specific guidelines on how to implement safer pest and crop management, and support in changing their farming practices.

Conventional farming relies heavily on chemical plant protection, which results in high risks and hazards associated with pesticides use as well as in dependency upon pesticides for the purposes of plant protection. While the public and decision makers often do not understand why significant reduction of pesticide use is necessary, some European governments, farmers' assocations, co-operatives and retailers are already convinced of the benefits and are putting it into practice. We wish to provide some of those examples.

This report focuses on pesticide use reduction strategies using a variety of public and private sector approaches and different instruments. The Dutch and Danish case studies cover government programmes supported by major stakeholders in the food chain, looking to reduce use of hazardous products and avoid environmental impacts. The Belgian and Italian cases were initiated by a farmers' association and an environmental NGO, respectively, with their own labelling and marketing schemes. The Belgian growers follow an Integrated Production approach, while the Italian label assures residue-free produce in conventional production. The Swiss case combines a strong focus on Integrated Production with government and supermarket support. The British case describes a set of guidelines for prohibiting and restricting specific pesticides and reducing dependency on chemical control implemented by one of the largest consumer co-operatives and farms in the United Kingdom. Whatever the instruments used to achieve pesticide use reduction (IPM, ICM, etc.), the goal is always to achieve sustainable agriculture producing food free of pesticides residues, protecting the environment and human health and ensuring adequate farm income both for small and large farmers.

By publishing these positive examples, PAN-E aims to:

- show that pesticide use reduction strategies are technically and economically feasible;
- offer practical examples relevant to the development of National Action Plans under the forthcoming EU Framework Directive on Sustainable Use of Pesticides and;
- encourage sharing of experience and lessons for food chain stakeholders, policy makers and civil society on approaches to reducing pesticide dependency.

The Netherlands

Striving towards sustainability

In 2003, the Dutch government adopted an Agreement on Crop Protection with the goal of reducing impacts of pesticide use, setting clear targets, and establishing an indicator to measure impacts. Major stakeholders from the farming sector, the pesticide industry and the water industry signed this agreement. Instruments such as crop specific 'Best Practices' and 'Environmental Impacts Cards' were also developed and adopted by a progressive group of farmers entitled 'Farming with Future'.

The Netherlands is the second largest exporter of agricultural products in the world, and the largest in Europe. In 2004, the Netherlands exported agricultural products worth 49 billion euros, the equivalent of 19% of the total export value in that year. Most exports go to other Member States of the European Union.

Ornamentals make up the bulk of agricultural export. In 2004, the value of ornamentals exports equalled 7.2 billion euros, almost 15% of the total agricultural product export value in that year. Other major export products in 2004 were meat (5.3 billion), dairy products (4.3 billion), tobacco (3.3 billion) and vegetables (3.2 billion).

In 2004, the Netherlands had 83,885 farms and over 15,000 were operating in vegetables production and in the glasshouse sector. Due to the limited land area and the specialisation on high value crops such as flower bulbs and glasshouse vegetables, the intensity of the agricultural production is very high.

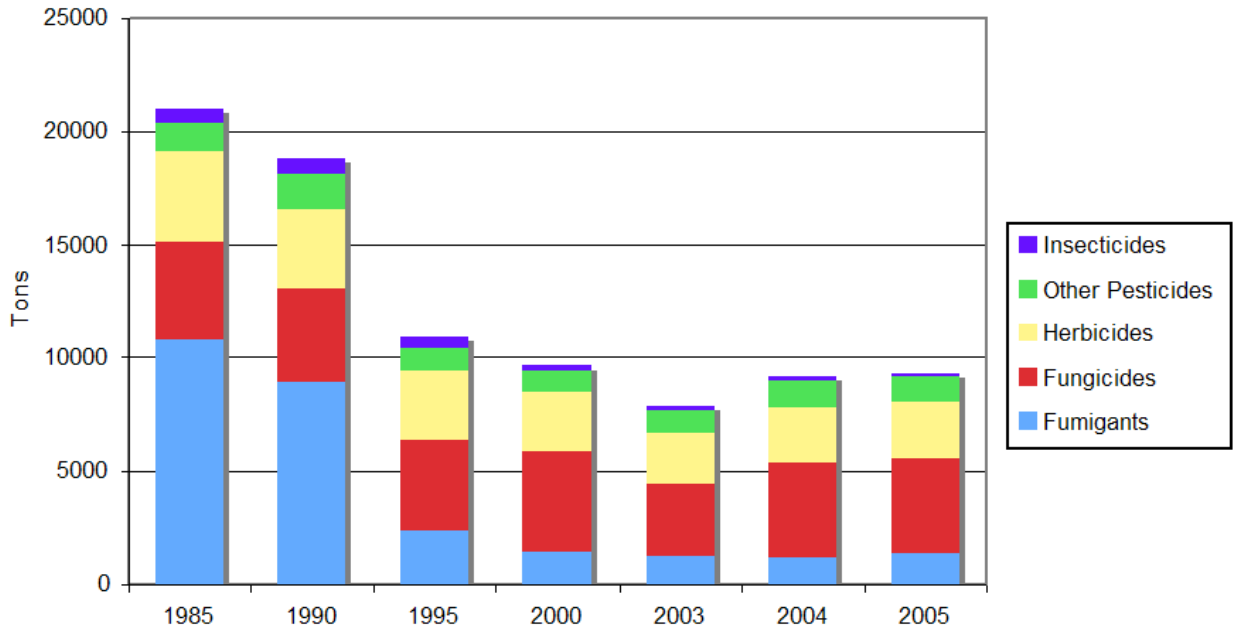
Table 1
Agricultural Exports (in Billion €) in 2003

Country	Value (Billion €)*
United States of America	57.2
The Netherlands	40.9
France	39.2
Germany	31.9
Canada	25.5
Spain	22.3
Belgium/Luxembourg	21.4
Brazil	19.8
Italy	19.2
China	19.0

*Original values were in US Dollars, calculation in Euro is based on the June 2003 exchange rate of 0.9 Dollar/Euro

Source: 9

Figure 2
Pesticide Sales (tons of active ingredients) 1985-2005 in the Netherlands



Source: 10

The high intensity of pesticide use combined with the presence of numerous water courses and drainage canals close to farmland makes the protection of water resources a major issue within the economic, social and environmental agendas in the Netherlands. Programmes for the reduction of pesticides use started as early as the 1980s resulting in a considerable decrease in the use of soil fumigants and, to a lesser extent, of herbicides.

Agreement on Crop Protection

The growing pressure and impacts of intensive farming on the environment, in particular water resources, as well as stricter requirements from EU Regulation culminated in a plan to implement sustainable methods throughout the Dutch agricultural sector by 2030[11]. The plan materialised in spring 2003, with the approval of the Agreement on Crop Protection to reduce the environmental impacts of pesticides.

The goals of the Agreement on Crop Protection are:

- to reduce the overall environmental impact of pesticides by 75% by the year 2005 in comparison to 1998 and by 95% by 2010;
- to reduce the impact of pesticides on surface water by 50% by 2005 and by 95% by 2010 in comparison to 1998;
- to reduce the percentage of food samples exceeding legal Maximum Residue Levels (MRL) by 50% by 2010 in comparison to 2003 and;
- to achieve usage of uniformly labelled and certified pesticide products by 100% of the farmers by 2010.

The Agreement on Crop Protection is a government initiative signed by several stakeholders: Ministry of Agriculture, Nature and Food Quality (MINLNV), Ministry of Housing, Spatial Planning and the Environment (VROM), Farmers Union (LTO), Pesticide industry (Nefyto), Suppliers of pesticides (Agrodis), Water Board (Unie van Waterschappen) and water companies (VEWIN).

The stakeholders agreed on four major elements:

1. promotion of innovation and improving management;
2. stimulation of sustainable production and consumption;
3. encouragement of effective and sustainable pesticide products;
4. control, monitoring and responsibility[12].

The first instrument is the most important in terms of resources and focuses mostly on the promotion of Integrated Crop Management. The annual budget for the implementation of the Agreement on Crop Protection is € 14 million[13].

Detailed measures to achieve and evaluate the pesticide reduction goal include:

- creation of a promotion campaign targeting individual farmers and farmer groups;
- continuation of research on specific pest problems such as potato late blight (*Phytophora infestans*);
- development of a set of 'Best Practices' per crop by the Applied Plant Research (PPO) at Wageningen University and Research;
- creation of an experimental advisory service for the implementation of the 'Best Practices' by the Ministry of Agriculture, Nature and Food Quality and implemented by DVL Agriconsult;
- financial support to the practitioner network Telen met Toekomst (Farming with Future) for public outreach;
- development and promotion of Environmental Impact Cards (a ranking system of pesticides based upon their environmental behaviour) as a guidance for farmers;
- development of a National Environmental Indicator in order to evaluate the results.

Best Practices

In April 2003, the Ministry of Agriculture, Nature and Food Quality commissioned the Applied Plant Research, an institute of the Wageningen University and Research, to describe 'Best Practices' in integrated crop management for all major crops.

'Best Practices' go beyond 'Good Agriculture Practice'. They have been tested by researchers and farmers and have the potential to contribute to the reduction of pesticide emissions and environmental damage. The intention was to identify the 10 most important measures for the main crops.

Measures that are already obligatory or commonly applied as well as measures with a relatively small contribution to the reduction of environmental damage were not included.

By 2004, 'Best Practices' were published for all important plant production sectors: arable farming, field vegetables, flowers, bulb growing, tree cultivation, fruit production, glasshouse vegetables, ornamentals and mushrooms. For the most important crops 'Best Practices' have been described by sector and published in separate reports.

All 'Best Practices' can be divided into two hierarchical categories that overlap for the greater part: a scientific hierarchy and the hierarchy as used in the agreement on crop protection[14].

Table 2
Scientific hierarchy and hierarchy according to Agreement on Crop Protection

Scientific hierarchy	Hierarchy according to Agreement on Crop Protection
Prevention	Prevention Cultivation technique
Determining control necessity	Warning and advice systems Non-chemical crop protection
Control	Chemical crop protection Emission restriction

The description of a 'Best Practice' for one crop is in general not longer than two pages. The first page consists of a table listing the individual measures and the second page gives a more detailed explanation and a list of references (see the Annex for the example of potato). Each suggested measure is then categorised into type and sub type according to the hierarchy developed for the Agreement on Crop Protection (Table 2).

Furthermore, each measure is weighted by the:

- degree of implementation;
- restrictions/limitations;
- contribution to the reduction of environmental impact and;
- application in organic agriculture.

For the weighting a scale from 1 to 5 is applied (Table 3).

Table 3
Weighting of 'Best Practice' measures

Degree of implementation	1 = generally in practice 2 = only at trendsetter farms 3 = only at experimental farms 4 = strategy still being developed
Restrictions/ Limitations	1 = cost 2 = labour 3 = risk 4 = perception of risk and unfamiliarity 5 = not registered
Contribution to reduction of the environmental impact	1 = reduced dependence on the chemicals 2 = big 3 = moderate 4 = small 5 = none
Application in Organic Farming	1 = measure applicable in organic agriculture 2 = measure not applicable in organic agriculture

Drafts of the 'Best Practices' were circulated for feedback to the appropriate growers association and their recommendations were considered in the final version.

Table 4

Type and subtype of 'Best Practice' measures according to the hierarchy developed for the Agreement on Crop Protection

Category	Sub Type	
Prevention	a	Healthy starting material
	b	Hygiene measures
	c	Treatment of soil (e.g. organic matter and rotations)
	d	Cultivation and crop rotation
	e	Choice of crop and variety
	f	Time of sowing or planting
	g	Knowledge of diseases, pests and weeds
Cultivation technical measures	a	Scouting/damage thresholds
	b	Plant distances and density
	c	Fertilization
Warning and advice systems	a	Using weather measurement systems, aphid traps
	b	Decision supporting systems such as GEWIS- (a weather-based decision support system for timing the application of pesticides)
Non-chemical crop protection	a	Using natural enemies
	b	Mechanical/thermal destruction of remaining foliage, e.g. of potatoes
	c	Mechanical techniques for weed control
	d	Choice of means for plant defence stimulators
	e	Crop protection products of natural origin (GNOs)
	f	Inundation
	g	Biological soil decontamination
Chemical crop protection and application techniques	a	Choice of pesticides
	b	Seed coating
	c	Spot application
	d	Low dosage system (LDS)
Emission restriction	a	Choice of pesticides
	b	Buffer crop/wider cultivation free zone

Environmental Impact Cards

Chemical control of weeds and pests is the last option in the hierarchy of the 'Best Practices'. With the right choice of pesticides farmers can reduce emissions and adverse effects on the environment. Environmental Impact Cards for each crop were developed in order to give farmers a decision tool for choosing the least adverse pesticide. These cards basically consist of a list of all authorised pesticides with a scoring system for environmental fate and the toxicity - a high score indicates a high environmental impact.

Supplementary to the scoring with numbers, individual fields are coloured. A green field stands for a lower risk, while a red field indicates a higher risk. For the assessment of the effect on beneficial organisms coloured capital letters ranging from A (green) to C (red) are used.

The cards are developed and provided by the Dutch Centre for Agriculture and Environment (CLM), which uses a computer model to calculate Environmental Impact Points (MBP). The model calculates emission concentrations and considers toxicity to beneficial and water organism.

Figure 3 shows an extract of the environmental impact card used by the practitioner network Telen met Toekomst (Farming with Future) for apple and pear. The card indicates, for example, that for the pesticide product 'Apollo' (active ingredient clofentenzine), the time for usage is March-August, the recommended dose is 0,45 litre/ha (0,23 kg active ingredients/ha), and the Environmental Impact Points (MBP) for groundwater is zero. However, Apollo's environmental impact on aquatic organisms is highly variable according to the season (before and after May 1st), and the percentage drift (17% - 1%).

Figure 3
Example of an Environmental Impact Card for Apple and Pear (Extract).

MILIEU-EFFECTENKAART 2006

Appel en Peer

Bij verschillende driftpercentages

clm

Telen met toekomst

Middel	Toe-passings-tijdstip	Advies-dosering	Kg actieve stof	Milieu-effecten								Nuttige organismen	
				Grondwater		Waterleven							
				organische stofklassen		voor 1 mei (drift)		na 1 mei (drift)					
				1,5-3%	3-6%	17% [4]	2,5% [4]	7% [4]	1% [4]	Lucht		Be-stui-vers	Be-strij-ders
		kg/ha of l/ha	kg a.s./ha	MBP	MBP	MBP	MBP	MBP	MBP	kg a.s./ha			
Insectenbestrijding													
Admire	mrt-aug	0,1 kg	0,07	350	10	0	0	0	0	0,00		C	C
Admire	sept-feb	0,1 kg	0,07	420	14	0	0	0	0	0,00		C	C
Apollo	mrt-aug	0,45 ltr	0,23	0	0	1071	158	441	63	0,00		A	A
Asepta carpovirusine	mrt-aug	1,5 ltr	0,02	0	0	0	0	0	0	0,00		?	A
Asepta Neemazal t/s [1]	mrt-aug	3 ltr	0,03	0	0	x	0	0	0	0,00		?	?
Bacillus thurigiensis (o.a. Xen Tari)	mrt-aug	1 kg	0,54	0	0	?	0	0	0	0,06		A	A
Calypso	jan-dec	0,25 ltr	0,12	?	?	x	29	x	12	?		B	B
Decis micro	mrt-aug	0,1 kg	0,01	0	0	731	108	301	43	0,00		B	C
Dimilin [2]	mrt-aug	0,4 ltr	0,19	7	7	x	x	x	108	0,00		C	B
Envidor	mrt-aug	0,4 ltr	0,10	6	2	x	0	x	0	0,00		?	?
Gazelle	mrt-aug	0,25 kg	0,05	146	13	0	0	0	0	?		?	?
Insegar 25 WG	mrt-aug	0,3 kg	0,08	0	0	459	68	189	27	0,00		A	B
Madex	mrt-aug	0,1 ltr	0,00	0	0	0	0	0	0	0,00		?	A
Masai 25 WG	mrt-aug	0,4 kg	0,10	0	0	x	59	165	24	0,01		A	B
minerale olie (o.a. Luxan Olie-H)	mrt-aug	30 ltr	24,00	150	0	0	0	0	0	2,88		A	A
Nissorun spuitpoeder	mrt-aug	0,4 kg	0,04	0	0	0	0	0	0	0,00		A	A
Pirimor	mrt-aug	0,5 kg	0,25	125	2	935	138	385	55	0,08		A	A
RAK 3	mrt-aug	500 ampullen	0,045	0	0	0	0	0	0	0,05		A	A
Runner	mrt-aug	0,4 ltr	0,10	88	4	0	0	0	0	0,01		A	A
Steward	mrt-aug	0,17 kg	0,05	1	0	x	5	x	2	0,00		B	C
Teppeki	jan-dec	0,14 kg	0,07	0	0	0	0	0	0	0,00		?	?
Onkruidbestrijding													
							1% drift [3]						
2,4-D (o.a. Damine 500)	mrt-aug	2 ltr	1,00	2	0		2		2	0,10		A	A

Source: 15

From Theory to Praxis

Telen met Toekomst – Farming with Future is a network of farmers founded in 1999. The aim of the network is to promote and practise sustainable agriculture. The first project phase 1999-2003 focused on the implementation of the EU Water Framework Directive. Since 2004 Telen met Toekomst has worked on the implementation of the Agreement on Crop Protection. The network is organised into sector specific working groups. Currently there are 37 working groups across all sectors with about 400 farmers in the network[16]. In cooperation with the external stakeholders, each working group works out an annual plan for plant protection and fertiliser usage. In order to accomplish the annual plan, participating companies receive intensive support from research (Applied Plant Research) and the advisory services.

One farm in each sector specific working group is monitored and the management is documented to measure achievements and to define next steps. Approaches, experiences and results of the monitoring farm are exchanged within the group. Each group also functions as a starting point for dissemination of 'Best Practices' to other farmers and stakeholders[17].

Telen met Toekomst maintains a website, which publishes news around the topics of pest management and fertilisation, reports about workshops and other farmers' experiences.

In the autumn of 2004, a first survey on the implementation of the 'Best Practices' was conducted and crop specific reports were published online[18]. The follow up report on the implementation in 2005 will be published in the near future[19].

Market incentives for the implementation of 'Best Practices' were limited until the Dutch supermarket Laurus decided to be a front-runner in environmental and Fair Trade policies and start supplying ICM produce, Marine Stewardship Council-certified fish and Fair Trade products in 2005. Producers started supplying a limited range of six products to Laurus (apples, pears, strawberry, parsley, cabbage, iceberg lettuce) but have expanded to other fruit and vegetables since then. Despite the farm gate price paid to farmers for the ICM produce being not much higher than the price paid for conventional produce, farmers do consider the differential to be an incentive. The result is that by the summer of 2006 several growers expressed the wish to join the groups of Laurus ICM suppliers if the range of products was expanded to other fruits and vegetables. In the beginning of 2007 Laurus started supplying glasshouse-grown products like tomatoes, cucumbers and sweet peppers, with energy consumption also included in the ICM guidelines. The next stage in the marketing process will be a special certification for ICM products[20].

Weed knowledge test during a Telen met Toekomst field day on maize
© Telen met Toekomst

Measuring Success
The indicator

The indicator used to measure the results of the Agreement on Crop Protection was created in 2004 and is entitled 'Dutch Environmental Indicator' for pesticides. It calculates the potential environmental impact of agricultural pesticides.

The developers submit pesticide specific information (physical and chemical properties), geographical data (soil, water ways, groundwater location, and climate), agricultural data (crop area, application techniques, and crop stages) and toxicological data into a database, which is also linked with a Geographical Information System.

The Dutch Environmental Indicator is capable of calculating the following indicators:

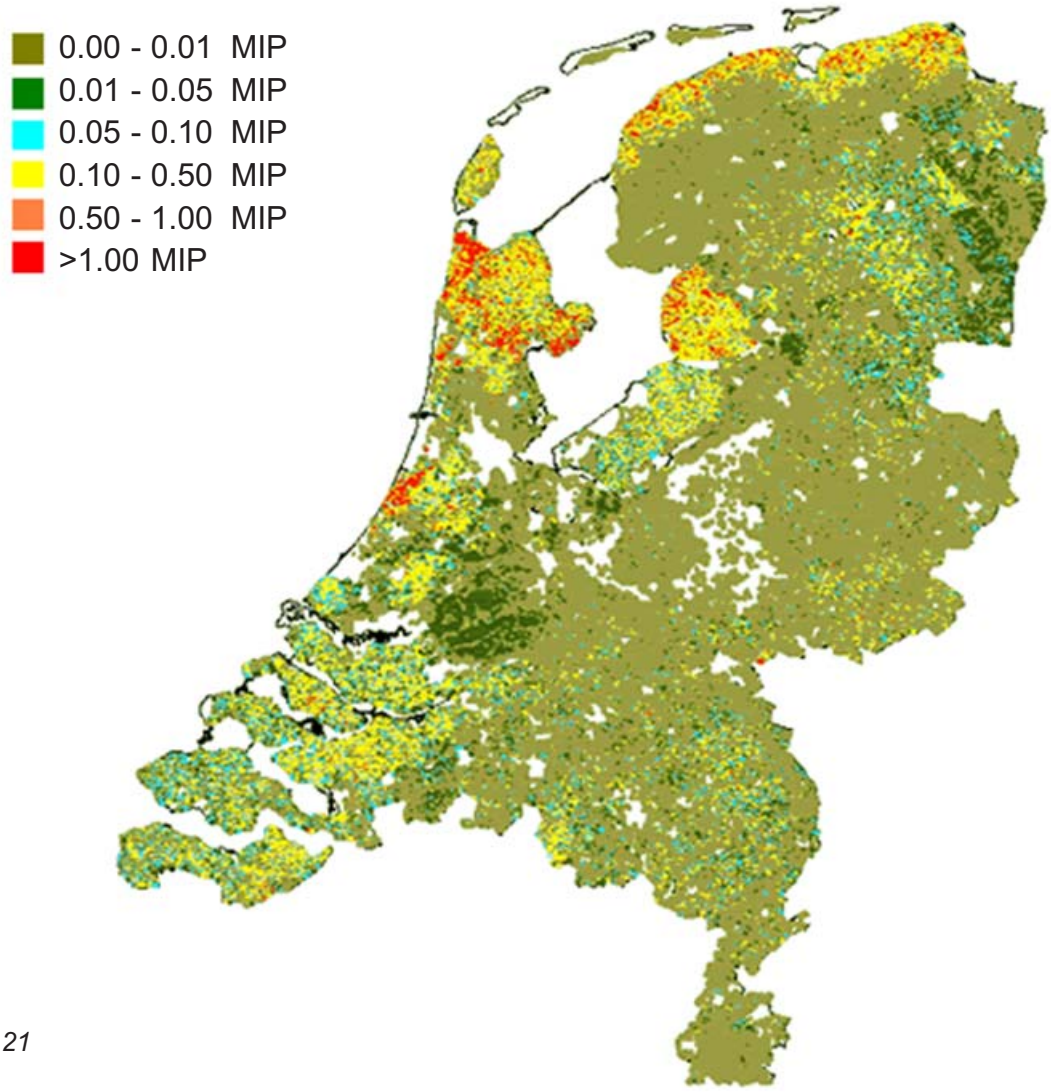
- emission of pesticide products to air, groundwater and surface waters;
- potential acute effects in the soil, surface water and to terrestrial organisms.

Emissions are calculated as amounts of active ingredients emitted from treated fields. Potential effects are expressed as Environmental Indicator Units similar to those used for the Environmental Impact Cards. The results can be visualised on maps (Figure 4).

Results can be presented per crop, agricultural sector, or the Netherlands as a whole.

A publication of the results of the first phase of the Agreement on Crop Protection for the goals of 2005 is planned by the end of 2006[22].

Figure 4
Annual drift of the insecticide chlorpyrifos to surface water expressed in Environmental Indicator Points.



Source: 21

Integrated Fruit Production in Belgium

GAWI & Fruitnet

Integrated Fruit Production by the growers' association GAWI started in 1988. GAWI developed their own standards for integrated production including a list of forbidden and allowed pesticides. GAWI organises farmers training and provides a warning service for the major pests and diseases. For marketing purposes the label FRUITNET® was established.

In Belgium there are around 52,000 farms with an average size of 27 hectares. Belgian farming is dominated by the production of livestock (65% of the agricultural land) and horticulture 22%. Due to chocolate and pastry exports, Belgium belongs to the top ten countries regarding agricultural exports (see Table 1). In 2004 organic farming was established on 712 farms covering about 24,000 hectares, mostly in the Walloon region[23].

GAWI Association

The Belgium not-for-profit farmers association GAWI (Groupement d'Arboriculteurs pratiquant en Wallonie les techniques Intégrées/ Walloon group of fruit growers applying integrated techniques) was created in 1988 by 10 fruit growers in the Belgium region of Wallonie.

The organization serves different purposes:

- to provide technical supervision for fruit growers practising integrated fruit production;
- to validate integrated production techniques and environmentally-friendly measures;
- to draw up and update the Fruitnet® specifications for the integrated production of pome fruit.
- to help draw up guidelines for the Integrated Production of other fruit and/or vegetable cultures[24].

The organisation has grown considerably and today GAWI represents 43 Walloon fruit growers with a combined production area of 820 ha of apples and pears, representing about 65% of the total fruit area in Wallonie. GAWI is financed by its members, which pay an annual fee of € 120/ ha and by royalties from FRUITNET, the marketing organisation, which pays € 0.49 per 100 kg of fruits sold to GAWI[25,26].

Integrated Fruit Production Guidelines

The GAWI guidelines for Integrated Fruit Production are based upon the guidelines of the International Organisation for Biological and Integrated Control of Noxious Animals and Plants (IOBC). The guidelines consist of 15 chapters and a list of pesticides recognised in Integrated Pest Management (IPM).

Integrated Production embraces more issues than pest and weed control. This is reflected in the 15 chapters:

- Registration and recognition;
- Qualification of the grower ;
- Conditions regarding the plot;
- Conserving the orchard environment ;
- The planting of a new plot ;
- Planting system for new orchards;
- Tree nutrition;
- Weed control;
- Fruit management;
- Integrated plant protection;
- Efficient and safe spray application methods ;
- Harvesting and storage ;
- Post harvest treatments;
- Organisation and number of controls;
- Recognised plant protection products for the integrated production method .

However, reduction of pesticide usage, enhancement of environmental conditions and protection of beneficial organisms are central in the guidelines.

The guidelines require for example that at least two of the following ecological options for the active enhancement of biological diversity

should be applied. These options are:

- the placement of nest boxes and/or perches for birds, for solitary wild bees, or of artificial hiding places for the hibernation of beneficial insects;
- to plant or preserve natural hiding places for the hibernation of beneficial insects (hedges, shrubs, bushes, etc.);
- to plant mixed hedges around the orchard as habitat for beneficial insects;
- to plant or preserve a weed strip, which contains for example Compositae and Umbelliferae;
- to preserve a counterbalancing ecological surface which covers at least 5% of the farm. Fertilisers or agrochemicals may not be applied on this surface.

If the width of a plot exceeds 100 meters, the plot should be separated or divided by annual or perennial 'fences' with a width of at least one metre. Soil fumigation is forbidden and weed control is strictly regulated. In Integrated Production orchards, bare soil between the trees is not permitted. The alley between the tree rows should have vegetation growing and this vegetation should be mowed regularly. The debris should be left covering the soil (mulching) to create a habitat for beneficial insects and preserve soil moisture.

The maximum width of the weed free strip - from the tree stem to the edge of the alley - must not exceed 75 cm, except for older trees with a wider canopy.

Only a maximum of four clearly defined herbicide treatments per annum is allowed.

Concerning the use of pesticides against pests, fungus and diseases, the guidelines require an assessment of the real risk of damage they represent before any pesticide treatment. The observation and control of population levels, as well as the presence and activity of key natural enemies and damage threshold levels must be used to estimate the risk for the entire plot.

Only pesticides that are listed in the guidelines are permitted.

The list is divided in three category lists:

Green list: these products are permitted when their use is justified;

Yellow list: these products can only be used if none of the products on the green list is suited for a justified and efficient use;

Orange list: these products may only be used after their necessity has been established and after permission by the control organisation has been given.

The growers cannot use more than two products off the orange list per year and per ha.

Training and Education

In order to obtain recognition as a certified Integrated Production grower the applicant has to:

- apply the Integrated Production method for at least two years as defined in the guidelines;
- know the Integrated Production techniques;
- attend at least three times each year a continuous training course of two hours. This course has to be recognised by a control organisation and cover all aspects of Integrated Production.

The control organisation checks the knowledge and participation in various activities. If this knowledge is considered insufficient when the grower applies for the first time, s/he will have to attend a 30 hour training course on Integrated Production within two seasons.

GAWI organises annually about 2-3 farmer group meetings for education on various subjects and 4-5 field trips. About 40-50 pest or disease warnings are sent out annually and during the season GAWI experts are daily available by phone[27].

GAWI also produced an interactive CD ROM, which explains integrated pome production with text, photos and video sequences.

GAWI regularly participates in public research programmes with a focus on fruit production. For example, under the European programme INTERREG, GAWI recently participated in a project to restore traditional fruit cultivars of the Belgian region of Hainaut in collaboration with the Regional Centre of Genetic Resources of the Nord-Pas-de-Calais region in France. Ten old apple cultivars have been planted experimentally on ten hectares (5 in Belgium, 5 in France).

Promotion and Marketing

In order to promote and market fruits produced by members of GAWI, the label 'FRUITNET' (see right) was created in 1991. Since 1996 this label has been used to identify IP produced pome fruit throughout Belgium.

In the same year, GAWI members founded the Belgian not-for-profit organisation 'FRUITNET'. Its goals are:

- to promote and defend integrated production in general, and the FRUITNET label in particular;
- to control the marketing of FRUITNET fruit;
- to ensure that FRUITNET specifications are followed;
- to control the use of the certification label.

In 1999 GAWI members founded a co-operative company named 'Fruitnet s.c.r.l.'. The objectives of this commercial organisation are to:

- find new commercial prospects and developing sales on existing markets;
- guarantee the intrinsic quality of FRUITNET fruit in compliance with specifications and the uniformity of batches;
- manage orders, prices, stocks and deliveries[28].

Today, 'Fruitnet s.c.r.l.' markets fruit from more than 75 Belgian producers representing almost 1,300 ha and 11-12% of the Belgian pome production. The Belgian retailing and distribution chain Delhaize-Le-Lion is the major seller of 'Fruitnet' apples and pears in Belgium, selling their produce in 120 national outlets. The consumer price is only about € 0.10-0.12/ kg more expensive than produce from other conventional sources[29,30].

In 2003, the European Fruitnet Group was founded to be able to offer a greater range of varieties of certified Integrated Production apples and pears. Besides the Belgian 'Fruitnet s.c.r.l.' there are four French members and one member from New Zealand[31].

Action Plans for Pesticide Use Reduction in Denmark

The first governmental Pesticide Action Plan introduced pesticide use reduction in Denmark in 1986. Since then a second and third Pesticide Action Plan have been adopted, both containing clear targets and timetables for pesticide use reduction and an indicator (treatment frequency index). The advisory service and a pesticide taxation scheme play a major role in the success of the Plans. In addition, the strict Danish approval system strongly reduced the availability of higher risk pesticides.

Denmark's agricultural area accounts for less than 2% of the total EU-25 agricultural zone, but the country has one of the largest average farm sizes (55 ha per farm). Agriculture is specialised in livestock and arable production. Cereals cover 57% of the arable land in Denmark with wheat and barley as the main crops. The importance of roughage production – consisting of both maize or barley silage and grass – used for feeding dairy cows is also quite high.

The organic production area covers about 6% of the total agricultural area, placing Denmark in the top 5 among the EU-15 countries. In terms of organic livestock, milk production is the most important sector. The production of organic eggs accounts for about 15% of the total Danish egg production[32].

Pesticide use reduction[33]

Pesticide use reduction was introduced in Denmark in 1986 by the first governmental Pesticide Action Plan as a response to a major increase in the use of pesticides and a serious decline in farmland wildlife in the beginning of the 1980's. The wild plant diversity in farmland, for example, decreased by 60% from 1970 to 1990, and the number of partridges fell by 70% from 1970 to 1985.

The main reasons for pesticide use reduction are:

- to protect consumers and agriculture workers against health risks and harmful effects resulting from the use of pesticides and from ingestion of pesticides residues through food and drinking water;
- to protect the environment against the harmful effects of pesticides, both direct and indirect, in farmland, water courses and natural habitats.

The first Pesticide Action Plan finished in 1997 and since then two other plans have been approved. The objectives of the three Plans are outlined in Table 5.

Table 5
Objective of the Danish Pesticide Action Plans

1986 - 1997	The first Pesticide Action Plan targeted a 25% reduction in total pesticide consumption by 1992 and 50% by 1997. It also comprehended measures to encourage the use of less hazardous pesticides.
1997 - 2003	The second Plan introduced the indicator treatment frequency index. The target was to reach a treatment frequency* of less than 2.0 before 2003 and establish 20,000 ha of pesticide-free zones along key watercourses and lakes.
2003 - 2009	The objective of the third Pesticide Action Plan is to lower the treatment frequency below 1.7 by 2009, to promote pesticide-free cultivation and establish 25,000 ha pesticide-free zones along watercourses and lakes. This plan includes the fruits and vegetables sector for first time.

*The treatment frequency index expresses the average number of times an agricultural plot can be treated with the recommended dose, based on the quantities sold.

In the last 20 years of pesticide reduction policy in Denmark a number of successful measures were implemented. Some of the most important measures are outlined below.

Advisory Service and Plant Protection Groups

Advisory activities for farmers are an important element of the Pesticide Action Plans. According to the plans, advice should address the correct use of pesticides, the feasibility of limiting use through changes in crop rotation, choice of seed varieties, mechanical and biological control, assessment of needs and improved spraying techniques. Great weight is attached to basing advice on financial as well as environmental considerations.

By far the majority of advisory activities are carried out under the auspices of farmers' organisations. 20,000 farmers subscribe to a weekly newsletter from the Danish Agricultural Advisory Service, a service belonging to and funded by farmer organisations.

The newsletter discusses pesticide products, preventive measures against insects, damage thresholds and the use of reduced doses. Information is also given on field trips for farmers. The Danish Agricultural Advisory Service estimated in 1997 that the average dose of fungicides applied by their members was about 35% of the pesticide label recommended dose, in contrast to 90% in 1987.

Plant protection groups consist of eight to ten farmers and an agricultural adviser. More than 95 of these plant protection groups were set up by 2001, meeting in the field several times each season to discuss topics such as herbicide selection and dosage and mechanical control options. These groups have had a major effect on farmers' choice and dosing of pesticides.

Changing the Pesticide Approval Scheme

The Pesticide Action Plan's goal of steering consumption towards less harmful products was made possible via the adoption of legislation. The Danish approval scheme for pesticides has been continuously tightened, and in the last few years, a number of products considered dangerous to the environment and health have been banned. Altogether 209 pesticides active ingredients were reassessed in the beginning of the 1990s, of which only 78 were given renewed approval. The rest were either withdrawn or not submitted for reassessment by their manufacturers.

Denmark has banned the use in agriculture of a number of substances given recent EU-wide approval by the European Commission (included into Annex 1, the 'positive' list of the EU pesticides authorisation directive 91/414).

Record keeping

Since 1994, farmers who have more than 10 ha have been required to keep spraying logbooks. This information is kept in the farm and not passed on to the authorities. The spraying logbooks serve to sharpen farmers' awareness of their pesticide consumption and therefore motivate them to reduce the usage. Since 2000, the national agricultural advisory service has set targets for pesticide usage in the different crops to ensure that farmers can meet the targets for pesticide reduction set out in the pesticide action plans. The targets are used as a control instrument at farm level and to make the reduction possibilities visible for farmers. In this way farmers can see if they are using more or less pesticide than the target, and where reductions are possible.

Pesticide Taxation

Up to 1996, fees were levied on the agrochemical industry, amounting to more than 3% of the wholesale turnover of pesticides. These charges financed the activities of the approval authorities, inspection and testing, research, information and training.

In 1996 the government introduced an ad valorem tax (VAT) on pesticides, replacing the 3% fee on wholesale turnover. The tax was increased in 1998 and pesticide retailers reduced their prices to counteract the effects of the tax.

Though the tax in 1998 was increased from 37% to 54% of the wholesale price, the farmers' price for insecticides was reduced by 6% from 1997 to 2003.

Today the tax amounts to 34% of the wholesale price in the case of herbicides and fungicides and 54% in the case of insecticides. 13% of this tax finances the activities of the approval authorities and research, 3.5% the pesticide reduction plan and 83.5% is returned to farmers through funds which finance a number of agriculture related activities.

When the tax was introduced, the resultant reduction in pesticide consumption was estimated at 5%-10%. The tax reduces the over use of pesticides and simultaneously makes other pest control measures more competitive, e.g. biological control and mechanical weed control.

Pesticide free buffer zones

The committee reviewing the first Pesticide Action Plan considered there to be a need for additional protection for certain ecosystems, and recommended the establishment of a 10-12 m no-spray buffer zone around natural wetlands.

There are about 64,000 km of watercourses in Denmark, of which 25,000 km are targeted for pesticide-free buffer zones. In addition, a 10m buffer zone was recommended for all lakes over 100m^2. There are about 120,000 such lakes, which brings the total area of buffer zones to about 50,000 ha.

Although the governmental target of 20,000 ha buffer zones was not reached by the Second Pesticide Action Plan, the Third Pesticide Action Plan will implement an increased target of 25,000 ha buffer zones along watercourses and lakes before 2009. The major financial instrument to achieve the target is a higher subsidy to farmers who place these areas under set aside.

Results of the Pesticide Reduction Plans

In Denmark pesticide use has been reduced from a treatment frequency of 3.1 in 1990-93 to 2.1 in 2001-2003 (Figure 5), but Danish investigations have shown that it can be reduced further to 1.4 without significant economic losses neither to the farmers nor the society. The tonnes of active ingredients sold halved since 1985 (Figure 6), but this may also be a result of the introduction of newer low dose pesticides, especially herbicides.

Since 1998 pesticides or their metabolites (breakdown products) have been detected in more than 50% of sampled shallow (0-20 m below ground surface) groundwater abstraction wells. During the period 1998-2003, the annual percentage of wells with concentrations exceeding the limit value 0.1 microgram/litre, declined from 10% to 5%. By reducing the treated area around water catchments, the number of applications and the pesticide dose rate, contamination of groundwater can be reduced significantly. The Geological Survey of Denmark and Greenland also concluded that a continuing reassessment of the pesticides approved today means that groundwater quality would improve significantly.

In 2003 pesticide residues were found in 45% of Danish produced fruits and in 79% of imported fruits of the same type. Only 7% of Danish produced vegetables contained residues but 42% of imported vegetables of the same type contained these. These figures show, that public awareness on pesticide residues has had a significant effect on the use of pesticides in foods.

A Danish study on the effects of reduced pesticide use on flora and fauna in agricultural fields shows that half and quarter doses of herbicides and insecticides give an increased number of wild plant (weed) species, increased proportion of flowering species and increased abundance of insects and birds. Use of half the dose only creates negligible, if any, agricultural problems, especially if supplementary control of particular weed patches is carried out.

Pesticides are often found in aquatic ecosystems. A review report concluded that pesticide use reduction reduces the probability of pesticide effects on biodiversity. A 50% reduction in pesticide treatment frequency index will reduce the probability of pesticide effects on crustaceans in typical Danish ponds from 55% to 25%.

Figure 5

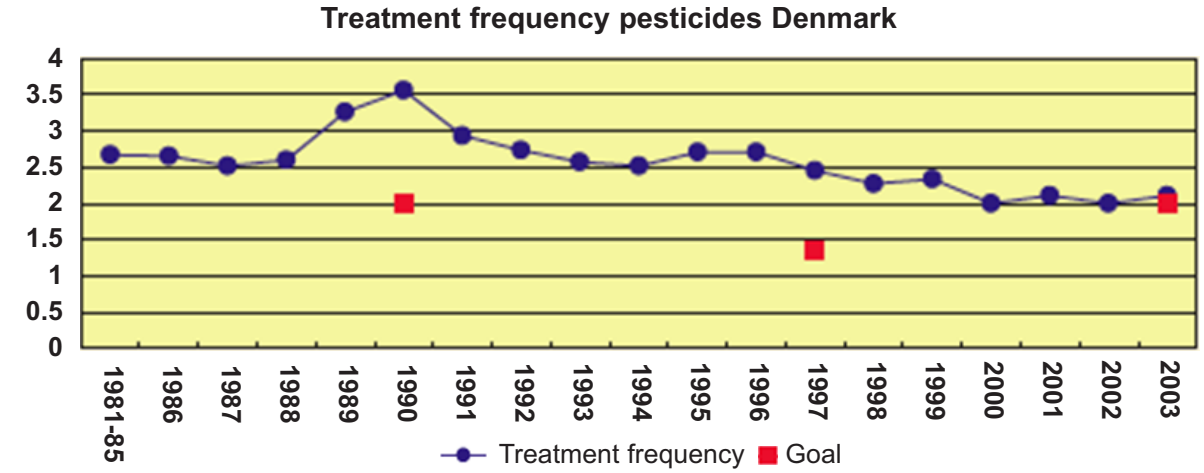
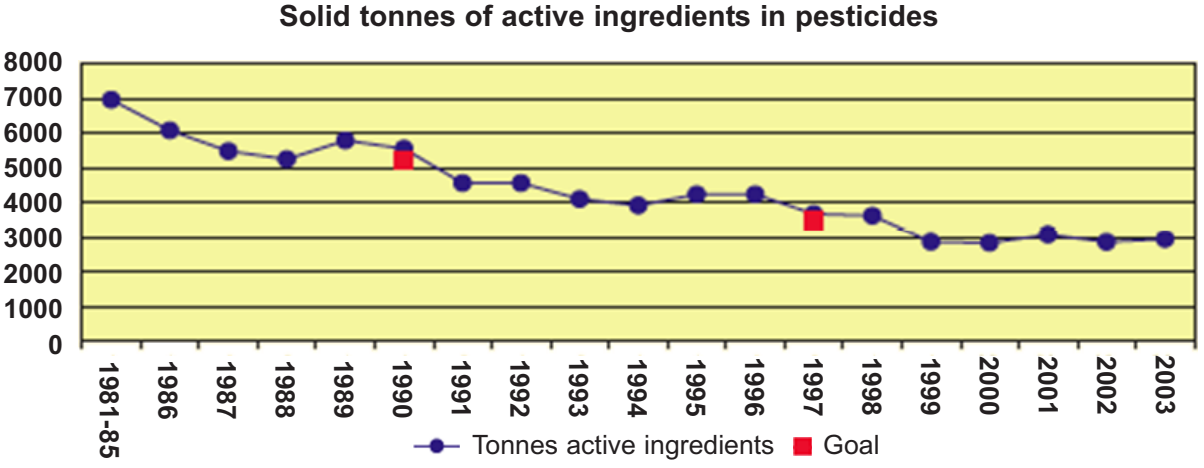


Figure 6



Many benefits – low costs

The result of the pesticide action plans is not only a decrease in the use of pesticides, but also higher farmer awareness of the pesticide problems, much fewer pesticide residues in Danish fruits and vegetables than in imported, banning of harmful pesticides, stronger use restrictions than in other European countries, better farmer knowledge about the effects of pesticides on the environment and better protection of the groundwater than in other European countries.

The costs of implementing the Danish pesticide action programmes are difficult to calculate. There is no evidence of the costs of banning pesticides. The costs of implementing organic farming not only covers pesticide use reduction but also better animal welfare, less use of fertilisers and food additives etc.

The Danish agricultural extension service has estimated that programme activities advising farmers have reduced pesticide use by 0.75 counted as treatment frequency index, corresponding to national cost savings of about 60 million euros per year. Though the lower pesticide use slightly reduces the yield, a significant part of the savings end up in farmers' pockets.

Integrated Production in Switzerland

In Switzerland there are two farmers' associations involved in Integrated Production. One is responsible for the fruit sector, the other for arable and animal production. Integrated Fruit Production in Switzerland follows the principles of the International Organization for Biological and Integrated Control of Noxious Animals and Plants (IOBC), while arable production developed its own standards including prohibition of certain uses.

Swiss agriculture represents a traditional agricultural system in a highly developed industrialized country. Today, agriculture plays a minor role in the Swiss national economy. But while it contributes only 1.4% to the GDP, it is the working place for about 190,000 full and part-time employees. The large agricultural work force is due to the fact that a large proportion of the country is mountainous and the farming system has been traditionally based upon small holders. About 81% of the farms are smaller than 25 ha and only 87 farms are larger than 100 ha[34].

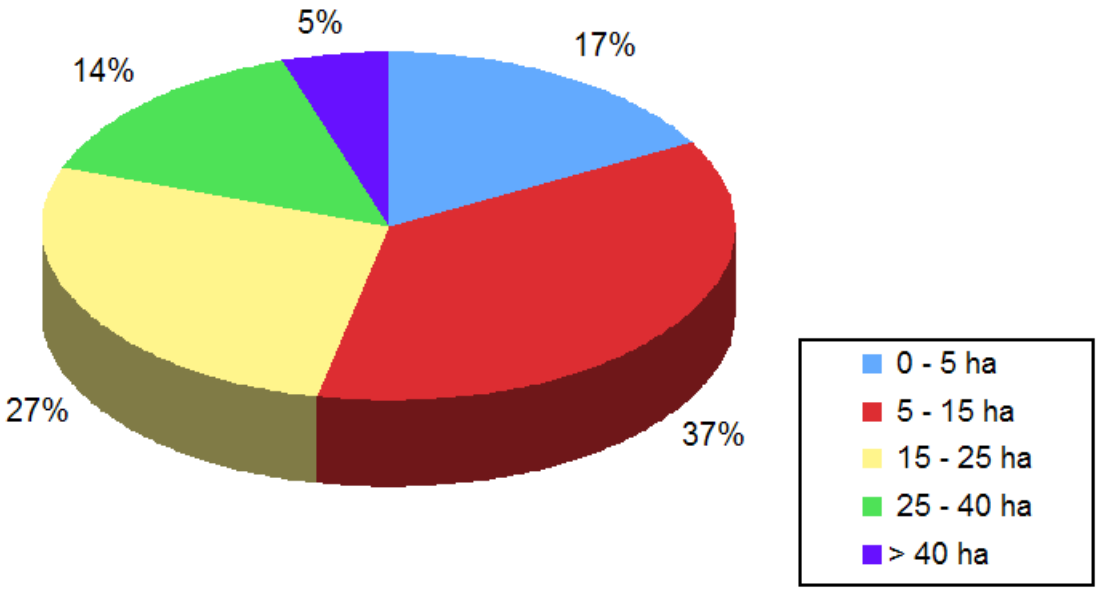
About 11% of the agricultural land and 10% of the farms in Switzerland are under certified organic production. The annual turnover of organic produce is almost 1.2 billion Swiss Francs (€ 0.8 billion) [35]. Taking into account that Switzerland has only some 7 million inhabitants, this figure is remarkably high*.

Direct payment scheme

In order to ensure food sovereignty, to maintain the natural living conditions, the cultural landscape and traditional rural structures, Switzerland regulates agriculture in its Constitution. According to the Constitution, the federal government has for example to complement farm income through direct payments. Payments are bound to an ecological activity confirmation by law[36].

In 2004 almost 100% of the entitled farms received direct payments. Altogether, almost 2.5 billion Swiss Francs (ca. €1.6 billion) were paid via direct payments[37]. Depending on the size of the farm and the location (mountainous or valley) the direct payments per farm varied between €15,000 and €40,000. Direct payments are divided into general payments and ecological payments.

Profile of farms by size in Switzerland 2004



*This is about €114 per capita/year. In Germany €56 per capita/year is spent on organic produce. However, organic food in Switzerland is more expensive than in Germany.

For both types of payments an ecological activity confirmation has to be supplied by the receiving farm.

The Swiss ecological activity confirmation, which has to be understood as the societal legitimating of direct payment requires among others things:

- an ecological compensation area for wildlife of 3.5% of the used area in specialty crops (fruit and vegetable) and 7% in other agricultural land;
- for farms with open arable land larger than three ha, a crop rotation of a minimum of four crops per year;
- permanent soil coverage through winter crops, green manure or inter crops;
- limited use of pre-emergence herbicides, insecticides and granular pesticides;
- small untreated control areas when pre-emergence herbicides are applied;
- usage of pest warning services and prognosis models;
- test of spraying equipment at least every four years.

Further payments are dependent upon a further reduction of the use intensity and/or increasing animal welfare. In 2004, about 20,000 farms received payments for especially animal friendly farming and some 11,000 farms received payments for extensive production of cereals for bread production. Subsidies were also paid for the extensive production of rape seed (ca. 2,000 farms) and cereals for fodder (ca. 13,000 farms) – however because farms receiving payments for different services overlap, the total number of farms producing extensive arable crops cannot be estimated. The estimated acreage under extensive arable production was about 77,000 hectare[38]. According to the direct payment regulation, extensive production requires the total abandonment of the use of insecticides, fungicides, plant growth regulators and chemical plant strengtheners. An amount of 400 Swiss Francs/ha (ca. 260€/ha) is paid as a compensation[39].

Integrated Production in Switzerland

Integrated Production (IP) in Switzerland is among the most comprehensive Integrated Production systems in Europe. While in most European regions where Integrated Production plays a major role – e.g. South Tyrol (Austria), Wallonie (Belgium) and Emilia-Romagna (Italy) – only a handful pf crops, mostly fruit, are grown under IP schemes, in Switzerland IP is extended to arable crops and even animal production.

There are two organisations setting and controlling IP standards:

SAIO - Schweizerische Arbeitsgruppe für Integrierte Obstproduktion (Swiss Working Group on Integrated Fruit Production) responsible for integrated fruit production including strawberries;

IP-SUISSE - Schweizerische Vereinigung integriert produzierender Bauern und Bäuerinnen (Swiss Association of integrated producing farmers) responsible for integrated production of arable crops, animal production and fruit for juice.

Similar to GAWI/FRUITNET in Belgium the IP guidelines of SAIO are based upon the guidelines of the International Organisation for Biological and Integrated Control of Noxious Animals and Plants (IOBC)[40]. Approximately 3,000 out of a total of 4,000 professional fruit producers grow fruits under certified Integrated Production, which is sold under the brand ‘Swiss Garantie’. The area under Integrated Production varies between crops, for example 92% of apples, 85% of strawberries and 70% raspberries are grown under IP schemes[41].

But while many farmers in several European regions carry out Integrated Fruit Production successfully, Swiss integrated arable production is unique in Europe.

IP-SUISSE

The Swiss Association of integrated producing farmers (IP SUISSE) was founded in 1989 and today has a membership of some 18,000 producers[42]. Integrated Production embraces seven different production sectors: meat, poultry, milk, cereals, rapeseed, potatoes and fruits for juice.

Similar to the IP schemes of the IOBC, there are certain basic requirements regarding farm management as well as crop specific requirements. To obtain an IP SUISSE certificate each farm must comply with:

- all legal requirements;
- standards of the ecological activity confirmation and certain subsidy programme (e.g. extensive production scheme for rape seeds and cereals);
- IP SUISSE farm management requirements (no GMOs, no sewage application, etc.);
- crop/livestock specific requirements.

Regarding the last point there is a certain flexibility, which makes the IP SUISSE scheme very attractive and offers safeguards to the IP farmer. For example, a certified IP potato farmer cannot use herbicides but can nevertheless sell conventional potatoes if he/she decides to use an herbicide in the season without losing the farm IP certification. Potatoes of the same variety cannot be labelled as IP SUISSE produce and will not receive premium prices in that year, however other varieties which were produced according to label requirements can be sold under the IP SUISSE label.

IP SUISSE developed specific guidelines for each crop/livestock. We will focus on the requirements regarding plant protection in arable production. The production of fruits for juice is in line with SAIOs' requirements for fruit production.

GUIDELINES FOR IP CEREALS

Wheat is the dominant cereal grown in Switzerland. In 2005, approximately 5,200 farmers produced ca. 110,000 tons of IP wheat for bread production[43]. This is about a third of the total Swiss production[44]. The producer price for 100 kg IP wheat ranged between 66.10 Swiss Francs (€ 41.90) for top quality and 54.78 Swiss Francs (€ 37.70) for Class II[45].

The IP SUISSE requirements for cereals are very strict regarding pesticide use:

- insecticides, fungicides, plant growth regulators and the use of synthetic plant strengtheners is not allowed;
- use of pre-emergence herbicides is not allowed;
- application of herbicides in autumn is limited to: rye production, foxtail (Alopecurus specific) control and direct seeding sites (zero tillage);
- herbicides containing the active ingredients 2,4-D, Dicamba, MCPB or MCPA cannot be applied;
- herbicides can only be used if damage thresholds have been calculated and main weeds have been documented.

Wheat cannot be grown two consecutive years in a rotation, and only certified seeding material can be used. It is also recommended not to grow wheat after corn. When IP wheat is grown, conventional production of wheat for bread on the same farm is not allowed[46].

GUIDELINES FOR IP OF POTATOES

In 2004 about 500 farmers produced ca. 1,200 ha of IP potatoes[47]. For 2006 a harvest of 30,000 tonnes is expected[48].

IP guidelines for potatoes were changed in 2004 and since then weed control has been exclusively mechanical because the usage of herbicides is no longer permitted. Chemical elimination of the potato foliage, before harvest, is only permitted in seed potatoes. In ware potatoes mechanical or thermal means of removal have to be used.

Disease control must be conducted in accordance with a warning or forecasting service. Systemic fungicides are only allowed if the warning system recommends such applications. The choice of fungicides is limited to the IP SUISSE pesticide list for potatoes, which contains only 14 fungicides (active ingredients). Colorado potato beetle and slugs are the only pests to be controlled via application of pesticides. For the control of the Colorado potato beetle there are 5 active ingredients available and for slug control there is only one active ingredient available.

Usage of chemical anti-germination agents (one active ingredient on the list) is only permitted for industrial potatoes, if a special approval of the processor is given[49].

A four-year break has to be respected in a rotation before potatoes can be grown again[50].

GUIDELINES FOR IP OF RAPE SEED

In 2004 about 2,000 tonnes of IP rapeseed was produced in Switzerland. The IP SUISSE requirements for rapeseed production are the same as for the extensive production under the direct payment scheme. The use of insecticides, fungicides, plant growth regulators and the usage of synthetic plant strengtheners are prohibited, while the use of herbicide is not limited. However, IP SUISSE requires that only certified seeding material is used and when IP rapeseed is grown, conventional production of rapeseed on the same farm is not allowed[51].

Adding value...

In addition to the IP requirements IP SUISSE started in 2004 a project entitled Skylark in co-operation with an ornithological organisation. The project does not focus solely on the skylark, rather the bird gives its name to a wider biodiversity project. The aim is twofold: on the

Skylark patch in a PIP cereal field in Switzerland © IP SUISSE

Pesticide Reduction

one hand it aims to increase biodiversity by giving habitats to endangered agro-ecosystem species, and on the other hand it aims to add value to the IP SUISSE production. With this project IP SUISSE can also deliver something that neither imports nor Swiss conventional production can compete with: a rich regional biodiversity.

The farmer can implement the Skylark project on a voluntary basis by undertaking the following measures:

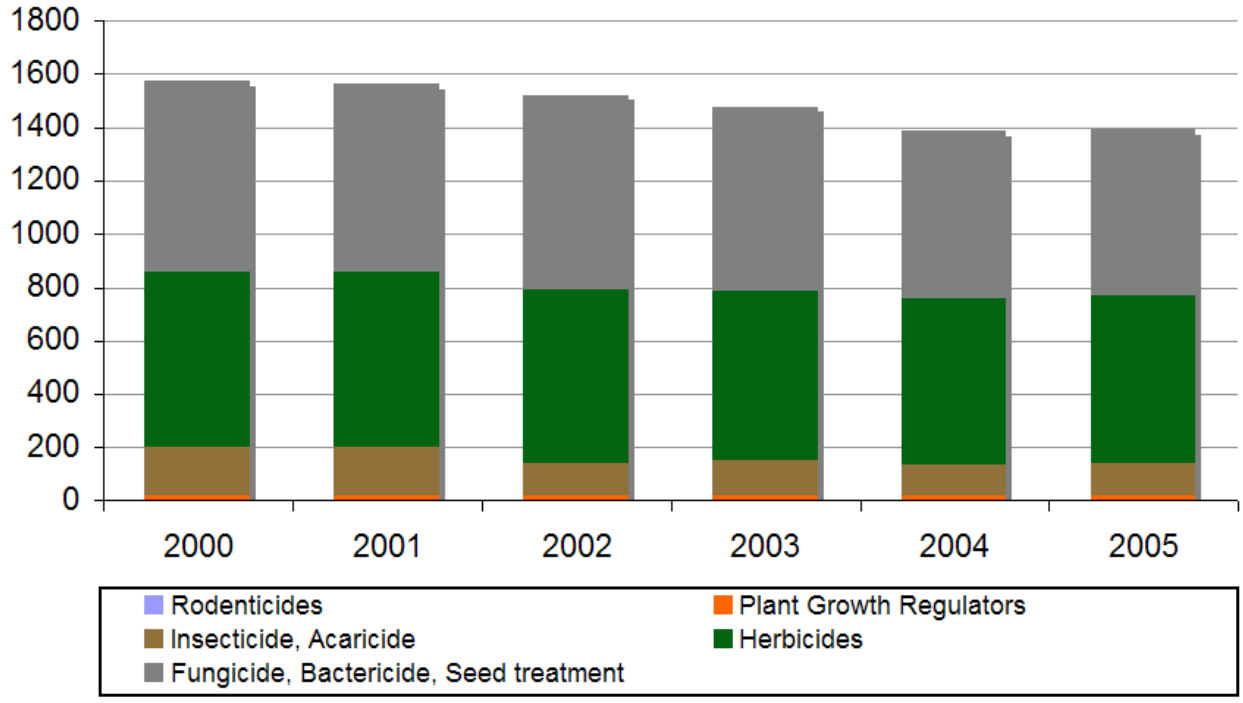
- with a wide seeding row of 22-26cm in cereal on at least 5% of the field (minimum total width 6m);
- leaving at least 3 uncultivated patches (size 3x6m) per ha.

Weed control is restricted in both cases: herbicides are allowed only until March 31. Mechanical control and broadleaf herbicides are not allowed. Seeding of green manure or clover is also not allowed. According to IP SUISSE, the project is very popular among farmers, with a minimum of 1,000 IP SUISSE certified farmers implementing these measures on a voluntary basis. IP SUISSE only provides Skylark participants with a small bag of seeds that farmers sow manually[52,53].

Pesticide use in Swiss integrated arable production is considerably limited: no herbicide use in potatoes and no use of insecticides, fungicides and growth regulators in rapeseed and cereals. IP SUISSE states that due to herbicide free potato production around 1.6 million litres of herbicides (formulated products) are saved[54].

However, exact figures on pesticide usage do not exist. Sales data show a decrease of 40% between 1990-2005, and looking at the period 2000-2005 overall pesticides sales decreased by 11.6%. The highest contributions to this decrease are decreases in the use of insecticides (-33.5%) and fungicides (-13.5%). The official agriculture report concludes that the 40% decrease in pesticide use between 1990 and 2005 is probably due to the implementation of integrated production but also to the introduction of low dose formulations in the 1990s[55].

Figure 8
Pesticide sales by use type 2000-2005 in tons active ingredients



Source: 56

Promotion and Marketing

IP SUISSE is not just a production system but also a recognised brand and a cereal seller. Promotion and marketing of IP SUISSE products is based upon 3 pillars:

- origin,
- quality,
- ecology/animal welfare.

A strong emphasis is placed on the fact that IP SUISSE products are 'Made in Switzerland'. 'Swissness' – a new word creation standing for national production of high quality products, not only in agriculture - is an answer of a small country to globalisation. As a non-EU member, Switzerland has to compete with an over mighty neighbour and protective tariffs are becoming increasingly hard to impose on trading partners. Nevertheless, the trend towards cheap food, especially in Germany, and the German 'Geiz is geil'* mentality, had a big impact on Swiss retailers. MIGROS and COOP, the two large retailers who jointly represent 80% of the market, introduced and extended cheap food lines such as M-Budget and Prix Garantee.

The reaction of IP SUISSE is better understood considering the contents of a recent press release: '*Everybody sells cheap No-Name products, but not everybody sells Swiss products with a clear added value!*'[57].

While 'Made in Switzerland' already stands for quality, IP SUISSE strives towards highest quality produce. Products and farms are independently controlled and all farms work according to SwissGAP, the equivalent to EurepGAP**.

IP SUISSE always stresses its environmental and animal friendly production not just for reasons of nature protection, but as an instrument to strengthen the profile of the brand. And while the examples of herbicide free potato production and the skylark project show that ecology is taken seriously, marketing has been extremely successful. All major retailers and food processors buy IP SUISSE products, including for example, McDonalds. All buns of McDonalds Switzerland are baked with IP SUISSE wheat; 63% of the meat and ca. 30% of the rapeseed oil come from IP SUISSE labelled farms[58]. In 2006, McDonalds also doubled its purchase of IP SUISSE potatoes for French fries[59].

One third of the bread sold at MIGROS is made with IP SUISSE cereals and most apple juice comes from IP fruits[60]. Potatoes and bottled rapeseed oil can be found in MIGROS' shelves. The Hiestand AG supplies all petrol stations with bread and about 120 bakeries sell bread and buns made of IP cereal.

In order to launch new IP products such as spelt bread, IP SUISSE works closely with the purchasing company. In general, IP SUISSE looks first for marketing options and then makes the contract with the farmers. For some products IP SUISSE works as a processor and vendor. It developed, for example, spicy rapeseed oil and does its direct marketing.

In addition, almost all IP cereal is bought by IP SUISSE, which maintains a 'strategic storage' to compensate 'good' and 'bad' production years and conducts cereal auctions[61].

To make the IP SUISSE brand more known to the public, many fairs and exhibitions are held each year. On one occasion a special sort of advertisement was placed on a field below a highly frequented highway (below).

* The English translation would be "Stinginess is cool"
** EurepGAP is a private sector body that sets voluntary standards for the certification of agricultural products around the globe according to Good Agricultural Practices (GAP).

Legambiente for Quality Italian Agriculture

The Italian non-governmental organization Legambiente started a campaign on sustainable agriculture in 2001 entitled "LAIQ- Legambiente per l'Agricoltura Italiana di Qualità - Legambiente for Quality Italian Agriculture" which certifies pesticide free food with the label LAIQ. To help farmers achieve the set standards and zero residues, Legambiente provides advice and support to farmers.

Italy's agriculture is dominated by small-scale farming - there are approximately 1.8 million farms and the average size in 2003 was about 6 hectares[62]. Most farms are organized into co-operatives. The Mediterranean climate allows the cultivation of a broad diversity of crops. Over 20% of the agricultural land is used for olive, grape and fruit and vegetable production. About 7% (over 1 million. ha.) of the agricultural land is under organic production. Much of the organic produce is exported, especially to Germany[63].

The LAIQ Campaign

Legambiente was founded in 1980 and is the largest environmental non-governmental organisation in Italy with 20 regional committees and more than 1,000 local groups. Legambiente runs national and international campaigns covering all major environmental policy areas such as reducing traffic and air pollution, against pesticides, proposing new energy policy, enhancing the use of renewable energy sources, etc.

Legambiente started a campaign on sustainable agricultural production in 2001. The initial focus was GMO free meat and dairy production and animal welfare, and was then extended to other aspects of agricultural production including pesticide residues-free fruit and vegetables.

The main goal of the campaign is to improve agricultural practices within the conventional sector. The campaign is entitled 'Legambiente per l'Agricoltura Italiana di Qualità - Legambiente for Quality Italian Agriculture' with the acronym LAIQ and has its own logo, which also serves as a label. Conventional products, which have been produced according to the requirements by Legambiente can receive this label.

Certification

The campaign primarily represents a self-certification scheme for agricultural co-operatives. The requirements for plant production are challenging: fruits and vegetables must not contain any traceable pesticide residues in order to receive the LAIQ label. Drift related residues below 0.01 mg/kg are tolerated but must be proven.

A co-operative or farmers' association which wishes to participate must prove that their produce does not contain any pesticide residues. They also have to pay an annual fee to cover the control costs and the support of an advisory service.

The participating farms must also fulfil the general and crop specific standards of Integrated Production as defined in the region. In Emilia-Romagna and Trentino regions, for example, the standards are based upon the IOBC guidelines and have been endorsed by the IOBC.

It is a not a requirement of the campaign that the entire area of the farm or all production of a specific crop must comply with the Legambiente's requirements. It is possible to 'convert' to the standards in a stepwise process,

and many co-operatives assign firstly a small acreage to gain experience.

There are three major instruments applied to reach zero residues:

- Integrated Pest Management (IPM) with a focus on biological pest control,
- usage of pesticides with a fast metabolism,
- extension of the pre-harvest time - the time between the last spraying and the harvest.

Participation

Some of the largest Italian co-operatives such as CALV and Terremerse produce some fruit and vegetables according to Legambiente standards.

Table 6 lists the names of the co-operatives involved, the 'Legambiente' area and the crops labelled. The table also shows that most co-operatives only assign small parts of their area. This is a reasonable approach considering that the Legambiente standard focuses on changes in conventional agriculture, which depends on pesticide usage.

Advice and Control

Legambiente is in charge of advisory and control activities and is engaged in a variety of partnerships with contract firms and agronomists. Legambiente works together with contract firms such as Italy Trading SAS Di Guglielmo Donadello & Co with related costs being paid by the co-operatives.

The co-operative is responsible for the implementation of IP schemes and for assistance to the individual farmers. Usually, co-operatives continue operating with their own advisory service and only apply for the label, if they are able to achieve the Legambiente criteria. However, in cases where residues are detected, a contract partner of Legambiente gives support to the farmer(s) to improve IPM techniques and reach zero residues.

In order to determine compliance and the state of the campaign, farms and contract firms must agree in a contract that Legambiente can perform controls on their activities at anytime. The controls are based on standard forms and check up lists, and include sample analysis to detect pesticides residues to be carried out in independent laboratories.

The participating farms must provide results of their own tests annually. The testing must be conducted before harvest and washing. In cases

Table 6
Co-operatives producing according to Legambiente standards (total size, hectare under Legambiente standards, crops)

Name of co-operative	Number of farms and/or hectare	Number of farms/ha following Legambiente standards	Crops labelled
Terremerse	7,000 farms 25,000 ha	29 farms	potatoes, peaches, apricots, onions, kiwi
CALV (Consorzio Agrario Lombardo veneto)	1,000 farms	52 hectare	potatoes and pasta in the near future
Solania srl		21 ha	tomatoes for processing
Valdadige	350 farms	204 farms	apples
In the process of evaluation			
Tognana (individual farm)	71 ha	21 ha	carrots
Ortoromi	200 ha	70 ha	lettuce
Atemi	230 ha	33 ha	Indian figs
Sicilia Agroverde	380 ha	27 ha	vegetables

Source: 64

where residues occur the produce cannot be labelled with the Legambiente label.

In addition, Legambiente takes samples in 5-10% of the farms and carries out tests without any notice. The laboratory tests sample 160 to 214 active ingredients depending on the crop. The list of analysed pesticides is reviewed annually.

Legambiente also assesses the pesticide storage conditions in the farms and checks the farmers' records on plant protection measures. A contract firm does this control.

Table 7 presents the results of previous years and shows that not all co-operatives managed to reach zero residues. The fungicide group Dithiocarbamate CS 2 (Maneb group), in particular, has been found at the lowest threshold. These results show that Legambiente has almost completely achieved the goal, apart for some low residues. For these cases, Legambiente, advisors and farmers are working together to improve their performances and gain experience.

Table 7
Results of analyses of samples taken at co-operatives producing according to Legambiente standards

Controlled crop (year)	name of Co-operative	Residues found
Apples (2005)	Valdadige	0,02mg/kg Dithiocarbamate (CS2), 0,104mg/kg Chlorpyrifos 0,051mg/kg Ethofenprox
Apples (2005)	Valdadige	zero
Apples (2006)	Valdadige	0,023mg/kg Dithiocarbamate (CS2), 0,022mg/kg Dithianon
Apricots (2006)	Terremerse	Zero
Nectarines (2006)	Terremerse	Zero
Peaches (2005)	Terremerse	0,02mg/kg Dithiocarbamate (CS2)
Potatoes (2006)	Terremerse	Zero
Potatoes (2006)	CALV (Consorzio AgrarioLombardo veneto)	Zero

Source: 65

UK Co-operative Group

The Co-operative Group is one of the largest consumer co-operatives in the world and is among the largest UK farmers. It started a pesticide policy in 1999 adopting a list of prohibited and restricted pesticides, a pesticides advisory service on pesticide use and alternatives and public outreach.

The Co-operative Group is one of the largest consumer co-operatives in the world. It was founded in 1863 focusing on food retail. Today, the group embraces different businesses and employs about 68,000 employees. In 2005, the food retail sector accounted for € 4.4 billion of sales[66].

The UK Co-operative Group runs a farming business, called Farmcare, which is a wholly owned subsidiary that farms Co-operative Group land (ca. 10,000 ha) and manages farms on behalf of other landowners (ca. 20,000 ha). Farmcare is the largest British farmer and supplies outlets with its own label 'Grown on Co-op farms'. By 2005, 20% of the Group's strawberries and 50% of the potatoes came from farmcare land.

The Co-operative Group has always been a frontrunner in selling organic and fair trade produce. Already in the 1980s it started to develop a pesticide policy[67].

Co-op strongly believes in the precautionary and the substitution principles: "*The Co-op believes the 'precautionary principle' should be applied to both new and existing pesticides: that is, we should stop using the pesticide where there is doubt about its safety, even if the weight of scientific evidence is insufficient to prove this conclusively... Equally, when a better or safer chemical is approved, the Co-op believes there should be a mechanism to eliminate more harmful chemicals which serve the same purpose.*"[68]

In 1999 a Code of Practice and guidelines on pesticide use and minimisation of pesticide residues were developed. As an additional instrument a list of pesticides prohibited and restricted was drawn up.

The current pesticide policy applies three major instruments:

- a list of prohibited and restricted pesticides
- advisory service on pesticide use and alternatives
- public outreach

Prohibiting and Restricting Pesticides

Already in 1999, the Co-op Group used a list of pesticides to support its pesticide policy. In 2001, the list was extended and the selection of pesticides was based upon stricter criteria. Authorisation status in the UK and EU, toxicity, environmental fate and listings within existing international agreements or conventions are taken into account for the inclusion or non-inclusion.

The following parameters are considered in the decision tree:

- authorisation status UK, EU;
- the Acceptable Daily Intake (ADI) in mg/kg*bodyweight as a measure for the chronic toxicity;
- the acute toxicity as classified by the World Health Organisation (WHO);
- the carcinogenic classification by the European Union (Directive 67/548 EEC), the International Agency of Research on Cancer (IARC) and the U.S. Environmental Protection Agency (U.S. EPA);
- the mutagenic and reproductive toxicity classification by the European Union (Directive 67/548 EEC);
- the potential to act as endocrine disrupter as evaluated by the European Union's review;
- occupational health assessments;
- the persistency in soil (half life) and mobility in soil;
- the persistency in surface water;
- the potential for bioaccumulation;

- a listing on the PIC (Prior Information Consent) list (Rotterdam Convention) and in the Stockholm Convention on Persistent Organic Pollutants (POPs)
- the category in the OSPAR (Oslo-Paris Commission) list.

The current list covers 24 prohibited and 31 restricted pesticides (69). The list contains a large number of pesticides that have been banned globally for agricultural use and a number of pesticides not allowed in the EU. However, some pesticides commonly used in the EU such as Linuron, Carbendazim, Mancozeb and Captan are on the restricted list.

Table 8 shows the list of prohibited and restricted pesticides.

Table 8
List of prohibited and restricted pesticide by the Co-operative Group (July 2006)

Prohibited	Restricted usage with permission by Co-op only
Aldrin+	Aldicarb
Dieldrin+	Benomyl
Endrin+	Captan
Chlordane+	Carbendazim
Hexachlorobenzene+	Chlordimiform+
Heptachlor+	Chlorothalonil
Lindane	Daminozide
DDT+	Dicofol
Cadusaphos+	Dienochlor+
Chlorfenvinphos	Disulfoton
Demeton-S-methyl+	Endosulfan
Ethoprophos	Fentin
Fenamiphos+	Ferbam+
Omethoate+	Lead
Phorate	Linuron
Phosphamidon+	Mancopper+
Prothiophos+	Mancozeb
Tebupirimiphos+	Maneb
Terbufos+	Mercury
Haloxyfop+	Methoxychlor+
Triazoxide	Metiram+
Captafol	Nabam
Chlordecone	Nickel Bis(dimethyldithiocarbamate)+
	Propineb
	Thiophanate Methyl
	Thiram
	Toxaphene+
	Tributyl tin+
	Vinclozolin
	Zineb
	Ziram
	Other ethylene thiourea and propylene thiourea generators

+ not authorized in GB

The Co-op list of prohibited and restricted pesticide is not only valid for farmcare farms. All suppliers – worldwide – have to comply with the list. For the application of restricted pesticides a written permission is needed. The permission is valid for one year. An estimated 3-4 requests are made monthly. Considering the listing of some very common pesticides this number is considered to be relatively low[70].

Looking for Alternatives

In order to move away from dangerous pesticides, Co-op supports farmers and research. Since 1993 it has supported research into Integrated Farm Management practices on one of the Farmcare arable farms. The assessment after ten years found that IFM methods are comparable to conventional in profitability. Costs for crop protection were a third lower than under conventional practice and volume of pesticide used almost halved. In 2002, wheat was grown successfully without any use of foliar insecticides, slug pellets or plant growth regulators. The significant reduction in pesticide use over the ten years was achieved mainly via good rotations, use of resistant varieties, thresholds and diagnostics for improved decision-making, some tolerance of certain pests and careful targeting of nitrogen fertilisation to reduce disease pressure[71].

The Co-op agricultural experts also developed advisory sheets for the growers. These include carrots, potato, cauliflower, mushrooms, and for avocado and pineapple from overseas suppliers.

Table 9 presents an example for tackling slug damage in cauliflower. In common with all sheets, it gives growers information on first preventing a particular problem from occurring, managing it via cultural, biological or mechanical methods as second choice, and finally, synthetic chemical control as a third choice. The sheets also give basic information on environmental and human health hazards and persistence, and other factors to consider in decision-making.

Table 9
Co-op Product Advisory Sheet (2001) for cauliflowers: Molluscicides - slug control

<table>
<tr><td colspan="3">1st choice: Prevention method(s) before crop establishment
Site selection- avoid known problem areas.
Good hygiene- at completion of harvest, plough in crop debris.
Consolidate soil to inhibit slug mobility</td></tr>
<tr><td colspan="3">2nd choice: Cultural, biological or mechanical methods post-establishment
Trapping-traps aid field monitoring and more effectively allow “patch treatment”.</td></tr>
<tr><td colspan="3">3rd choice: Current UK approved pesticide intervention</td></tr>
<tr><td>AI: metaldehyde
Example: Escargo 6
Chemical group: Other</td><td>AI: methiocarb
Example: Draza
Chemical group: carbamate</td><td rowspan="6">Comments or guidelines for use:
Use of metaldehyde is preferred due to lower environmental toxicity. It has also been shown to be less damaging to ground beetle populations than methiocarb.</td></tr>
<tr><td>Environmental persistence:
Wide range</td><td>Environmental persistence:
Slightly to moderately (18-41 days)</td></tr>
<tr><td>Environmental toxicity:
Mammals- Low
Birds- Low
Fish- Moderate
Invertebrates-Moderate</td><td>Environmental toxicity:
Mammals- Moderate
Birds- Moderate
Fish- High
Invertebrates-High</td></tr>
<tr><td>Human health toxicity:
WHO Class III</td><td>Human health toxicity:
WHO Class Ib</td></tr>
<tr><td>Co-op restrictions on use:
None</td><td>Co-op restrictions on use:
Monitored</td></tr>
</table>

Assured Produce Scheme

All UK horticulture farmers supplying Co-op must also comply with the crop specific protocols developed by Assured Produce a wholly owned subsidiary of AFS (Assured Food Standards). The Assured Produce Scheme (APS) focuses on the production of assured fruit, salads and vegetables[72].

The Assured Produce Scheme developed generic production protocols and crop specific protocols. These protocols contain 'Critical Failure Points', recommendations as well as voluntary measures expressed as 'shoulds'.

In order to attain full member status within the Assured Produce Scheme (APS) farmers need to check up an APS checklist and all questions suffixed by 'Critical Failure Points' must be complied with, together with a required percentage of the 'strongly recommended' questions (the required percentage score is outlined in the APS Checklist). Compliance with the "should" questions, which are verified in the Assured Produce assessment are not part of the certification and should be aimed for as they are considered Good Agricultural Practice[73].

The Assured Produce generic protocols have been successfully benchmarked against current EUREPGAP standards for fresh produce therefore any producer meeting the Assured Produce standards also meets EUREPGAP requirements.

According to APS the crop protocols are unique to the scheme and describe best existing production practice, highlighting integrated pest, disease and crop management systems for each specific crop. However, they are not intended to be a 'growers' guide' but they do outline current commercially acceptable best practice[74].

The protocols highlight integrated production, but are not oriented on the internationally recognised guidelines of the IOBC.

Public Outreach

The Co-op Group uses mainly the Internet for public information. It maintains a 'Guide to Pesticides' with general information about pesticides and its policy. The lists of banned and restricted pesticide can be found as well as results from Co-op's residue monitoring. The online reports show the monitoring results by month and include detailed information on residues of banned and restricted pesticides and MRL exceedances. When banned pesticides were detected possible explanations for the occurrence and the consequences (sanctions) are described.

Conclusions

The first conclusion we can draw from this report is that pesticide use reduction can be achieved via a variety of strategies and instruments. The case studies provide both national and regional examples with the main drive coming from government policies, farmers' associations, private companies and NGOs.

The second conclusion is that there is no single way of achieving use reduction and a sustainable production system, rather that it takes a step-wise approach and a combination of different instruments. All cases departed from conventional agriculture systems and evolved into more sustainable systems showing that change is possible. The main elements identified in the success of the different case studies are as follows:

- a strong legislative framework for pesticide use reduction and/or sustainable agriculture;
- targets for pesticide use reduction;
- clear standards and guidelines per crop, e.g. Best Practice lists, Integrated Production guidelines, zero-residues standards, frequency of application index;
- availability of training and advisory services for farmers which are independent of agrochemical companies;
- market incentives in the food chain, e.g. direct payments to farmers, higher price for products complying with certain standards;
- clear labelling and a marketing strategy behind the products;
- a drive towards reducing environmental impacts of agriculture and pesticide use;
- a reliable control system;
- monitoring indicators to measure progress; and
- resources devoted to build consumer awareness.

These elements are summarized in the table below. The case studies include a combination of different elements but the key elements that are present in all case studies are the existence of clear standards and guidelines per crop; independent training and advice; and a reliable control system. Next, we will try to summarize the main strengths and weaknesses of each case study.

	Netherlands	IFP in Belgium	National Plans in Denmark	IP in Switzerland	Legambiente LAIQ campaigne	UK Co-op Group
Strong legislation framework	x		x	x		
Targets for reduction of use and impacts of pesticides	x		x			
Clear standards and guidelines *per* crop	x	x	x	x	x	x
Research	x	x	x	x		x
Training and advisory services	x	x	x	x	x	x
Market incentives for other support		x		x	x	x
Clear labelling and marketing strategy		x		x	x	x
Focus on environmental impacts	x		x	x		
Control systems	x	x	x	x	x	x
Monitoring indicators	x		x			
Consumer awareness	x	x		x	x	x

Netherlands

Striving Towards Sustainability

High intensity of pesticide use combined with the presence of numerous watercourses and drainage canals close to farmland makes the reduction of environmental impacts of pesticides a major issue in the Netherlands. One of the keys for success in the implementation of Best Practice standards for all the main crops is therefore a strong environmental drive, with targets for the reduction of the environmental impacts and progress measured via an easy to use environmental indicator, useful at farm and regional levels. The good organisation among farmers, with the involvement of a network of farmers (Telen met Toekomst – Farming with Future) supported by an independent training and advisory service (DVL Agriconsult) is also of key importance.

The challenge remains to mainstream best practice across all Dutch farms, without specific market incentives for produce using Best Practices and in the face of competition with cheap imports. At least one retail chain is now taking up this challenge and supporting its growers to change practice.

Integrated Fruit Production in Belgium

GAWI and Fruitnet

The Wallonie IP Fruit Growers members are enthusiastic about Integrated Fruit Production because there are financial incentives in the form of savings on pesticide applications and a higher price from retailers for certified Integrated Production fruit. IP standards are clear and farmers are supported by an independent advisory and training service. There is also a clear labelling system (Fruitnet) and a good marketing strategy, with the large national supermarket chain Delhaize-Le-Lion selling Fruitnet produce in over 120 outlets in Belgium.

The challenge is to expand these practices to all Belgian fruit growers and into other crops and other retail chains.

Action Plans for Pesticide Use Reduction in Denmark

This case study offers an example of a successful response to a governmental programme for pesticide use reduction. There is good compliance of farmers because they have yield and income related incentives and an independent efficient training and advisory system behind them. Targets are clearly set in the beginning of the Plan and progress is measured with the frequency of applications indicator. There is a clear absence of market incentives and a marketing strategy but this is overcome by the high production efficiency of Danish farmers and the absence of high levels of pesticide residues in food when compared to food produced in neighbouring countries, giving Danish produce an immediate consumer appeal.

The challenge for Danish farmers is to achieve the latest strict application frequency targets, especially when competing with growers in other EU countries.

Integrated Production in Switzerland

This case study ticks practically all the elements identified for success. What could be taken as a disadvantage for Swiss agriculture (small scale farms in mountainous areas) is a trademark for success. Farmers have clear incentives to produce according to the IP guidelines in terms of higher direct payments and a higher product price. There is also a high degree of flexibility in taking up Integrated Production and a good independent training and advisory service available for farmers. There is a strong environmental drive behind the adoption of Integrated Production and a common understanding by all the actors in the food chain that 'Made in Switzerland' stands for quality. Marketing has been extremely successful with all major retailers and food processors buying IP SUISSE certified products.

The relevance of the Swiss model to the EU countries is sometimes questioned. However, the challenge is for the EU to achieve a strong political commitment and combine this with major support from the food sector.

Legambiente for Quality Italian Agriculture

This case study exemplifies a first step towards a sustainable system and a campaign undertaken by a not-for-profit organisation. There are clear guidelines for farmers joining the scheme and support via independent advice but no environmental drive or monitoring indicators to measure progress. There is a clear labelling system (LAIQ) and a good marketing strategy, with consumers and retailers accepting a slightly higher price for products that comply with stricter environmental and animal welfare criteria.

There are practically no resources devoted to research and little information on how LAIQ farmers are changing practice. The challenge for Legambiente is to build to the next step of reducing pesticide dependency and move to a more holistic production system.

UK Co-operative Group

This case study provides a successful example of a retail company deciding to be a front-runner in terms of reducing pesticide use and their impacts. The Co-op Group prohibits and restricts usage of certain pesticides based on their intrinsic hazards, has developed advisory sheets for growers to avoid pesticides if possible and to use the least hazardous products. It actively supports its farmers with advice, training and research. There was no specific marketing strategy, as the initiative was driven by demand expressed by Co-op consumers for produce that complies with stricter environmental and health criteria. The initiative has also spurred some other UK supermarkets to start similar policies.

The challenge for the Co-op is to remain the front-runner and to support further moves to more holistic production systems, with less overall reliance on pesticides.

Recommendations for EU-level policy and food

It is clear from the cases we examine that there is no single blueprint for success and that with the variety of farming and retail systems in the EU-27 countries, production regions and cropping sectors need flexibility to decide what are the most useful approaches for them to reduce dependency on pesticides. However, there are several common elements of success that are highly relevant and for which we need EU-wide policy support:

- a strong commitment to reducing pesticide use and dependency;
- an enabling policy environment to deliver this commitment;
- clear support from markets and consumers;
- independent training and advice for farmers;
- complementary incentives and signals from public and private sectors;

The development of the EU Framework Directive for the Sustainable Use of Pesticides provides a unique opportunity for policy support to the elements of clear crop-specific guidance; advisory support for farmers; and a reliable control system. These elements should be considered as a minimum when drafting National Action Plans in the framework of the new Directive. When defining guidelines for crop specific standards of Integrated Crop Management, the following 10 minimum criteria should be considered.

1 – a soil structure serving as an adequate buffering system for agriculture;
2 – a crop rotation frequency enhancing a balanced population of soil organisms, preventing outbreak of soil-bound pests;
3 – use of the best available pest-resistant (non-GMO) crop varieties;
4 – optimal crop distance and crop management to prevent growth of fungi;
5 – availability of refuges for natural enemies of pests and for the prevention of pesticide-resistant pests;
6 – economical nutrient management on the basis of information of already present nutrients in the soil and of the soil structure, and dosage only on the crop;
7 – in principle only mechanical weeding (or other non-chemical methods like the use of heat); only exception in case of bad weather conditions;
8 – use of pesticides based on information of presence of pests (scouting, sensors, on-line services) and only the use of selective (not harming beneficial organisms) pesticides which are not persistant, bioaccumulating or toxic;
9 – priority is given to the use of “green” (non-synthetic) pesticides and pest-preventive substances;
10 – minimal material resources input.

Source: 75

There is already considerable experience in using such standards in the Netherlands and in several Integrated Production initiatives. The EU’s new ENDURE research project for sustainable pest management will provide further practical information on best practices and promising methods for several pilot crops, over the next three years[76]. Consumer pressure and food retail sector interest in zero residue food and pesticide reduction is increasing. What is needed now is a definite political commitment from the EU to set a supportive policy framework for Integrated Pest Management within a holistic ICM context and the appropriate resources and incentives to help farmers supplying Europe’s markets to implement this.

BEST PRACTICES POTATO

IPM-measures to be implemented in potato growing	Coding measure subtype	Implementation grade in practice	Constraints	Contribution to lowering environmental pressure	Useful in organic cultivation	Short comments on measure
Explanation of the codes used	See chapter on IPM hierarchy	1= used generally 2 = use on front-running farms 3 = use on experimental farms 4 = strategy in development	1 = costs 2 = labor 3 = risks 4 = risk perception 5 = no authorization	1 = creating independence of chemicals 2 = big 3 = medium 4 = small 5 = no contribution	1 = of use in organic crop growing 2 = not useful	
1. Chose the best resistant variety against Late Blight/Phytopthora	1e.	1-2-3	2-3	2	1	First and for all it is important to chose the best Phytopthora-resistant variety. Dosing and frequency of treatment with fungicides can be reduced. Resistance against soil nematodes is also useful
2. Use of recent nematode-analysis of the soil for the choice of crop, rotation frequency and variety	1g.	2-3	4	2	1	Nematodes giving root knot should be virtually absent. A wide crop rotation is the best strategy for avoiding accumulation of these nematodes. Some green plants are also capable of reducing the nematode-numbers.
3. Use of pesticides against Rhizoctonia on the basis of damage threshold	2a.	2-3	3,4	4	2	Knowledge and use of Rhizoctonia-index is necessary. (Rhizoctonia is a soil-bound fungus and can give rise to stem and stolon canker).
4. Moderate fertilization with the use of stepwise dosage system	2c.	2-3	2,3,4	3	1	Stepwise dosage system based on cropscan, analysis of foliage and/or analysis of minerals (N, P, K)
5. Chose the 'environmental' strategy in the decision supporting system (*) for Phytopthora management	3b.	2-3	1,2,3,4,5	3	2	In stead of choosing 'low costs' or 'avoiding risks' the decision supporting equipment should be programmed on 'environment'

6. Use of GEWIS (**)	3b.	2-3	1,2,4	3	2	GEWIS is a decision supporting system reducing the use of pesticides by advising the optimal spraying moment
7. Develop and use FAB-plan	4a.	4	4	3	1	Use of Functional Agro Biodiversity (like small zones with wild herbs and flowers) raises the number of natural enemies of pests
8. Use mechanical foliage killing	4b.	2-3	2,3	1	1	Burning or crushing foliage substitutes chemical treatment
9. Use mechanical weed killing	4c.	2-3	2,3,4	1	1	Before planting mechanical weeding should be standard; after planting special equipment can kill weed mechanically in rows and even between plants (‘finger weeders’).
10. Choice of pesticides used	5a.	2-3	4	2	2	Knowledge of unwanted effects of pesticides is missing
11. Avoid pesticides which kill natural enemies of pests	5a.	3	4	3	2	Knowledge and awareness is missing in the agricultural world
12. Treatment of seeds against aphids	5b.	2	1	3	2	Use of a pesticide while sowing prevents full field spraying

(*) a decision supporting system is a kind of a weather station monitoring and predicting from day-to-day temperature and humidity conditions; on the basis of this the necessity of spraying is determined and advices to the farmer. Strategy can vary from ‘low costs’ to ‘normal’ to ‘environmental.
(**) GEWIS is a decision supporting system monitoring wind speed, temperature etc. and bases the advise HOW and WHEN to spray on these data combined with local conditions.

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