TOOLS

Introduction:

Building a training session in Integrated Pest Management (IPM) not only requires thorough knowledge and understanding of the principles and concepts of IPM, but also the ability of the trainer to adapt the training session to the participants.

The first step to a successful IPM training session is the identification of the type of participants. Farmers may, for example, require a more practical training session compared to advisers. The more focused the group is, the easier it is to make the training interesting and participative for that particular group.

There are a number of **interactive** tools available for trainers and trainees. These include the **ENDURE Information Centre**, which is a large database with state-of-the-art IPM information open to everyone. **EuroWheat** and **EuroBlight** are two crop-specific databases with information about fungicide use in wheat and late blight in potatoes respectively. Both databases cover several European countries. Use these interactive tools to not only gain knowledge about IPM, but also to show participants where to find out more about IPM.

IPM should not only be implemented in individual crops, fields or years, but should rather consider the whole **system**. The guides in the ENDURE IPM Training Guide focus on specific crop rotations based on **6 major cropping systems** studied in Endure and Pure (www.pure-ipm.eu). Use the examples to give practical information to farmers, for example, about how to design 'IPM-like' crop rotations.
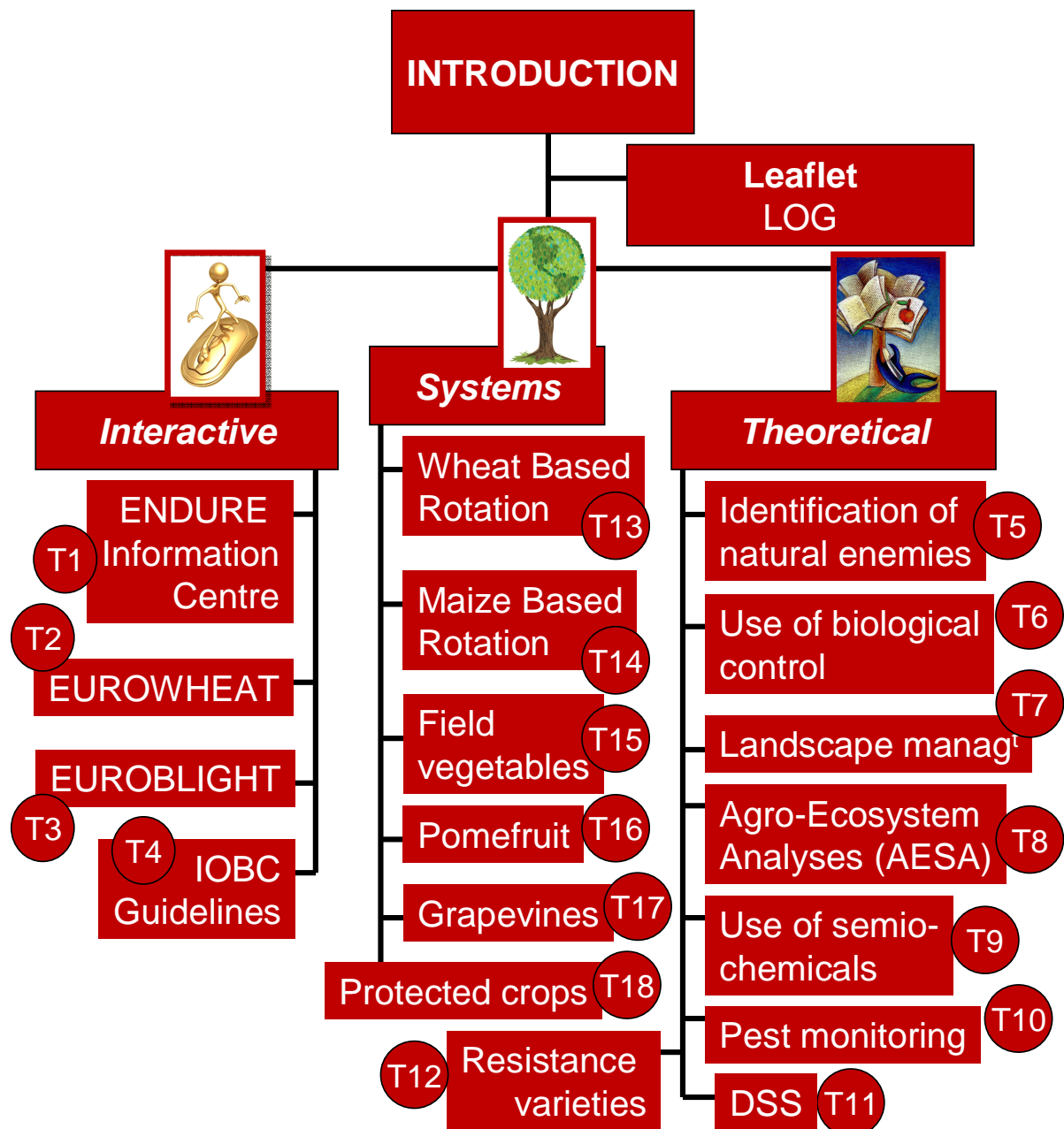
The knowledge about how pests, diseases and weeds work and interact, in other words the **theoretical** background, is a cornerstone of IPM. Whether it is the ability of the farmer to **identify natural enemies**, use **monitoring tools**, use **Decision Support Systems** or maybe even make an **Agro-Ecosystem Analysis**, it is important that the trainee learns how these tools work in practice and how to relate them to the chosen crop protection method. The ENDURE IPM Training Guide also provides theoretical information about how and when to involve the use of **biological controls**, **landscape management**, **resistant varieties** and the use of **semiochemicals** in an IPM system.

An efficient way of learning is to use visualisation. A leaflet about how to use logarithmic spraying for demonstration purposes is available for inspiration.

The tools available in the ENDURE IPM Training Guide do not offer the complete package of training tools, but provide the basic foundation for building interesting and robust IPM training sessions.

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TOOLS T 1	**ENDURE INFORMATION CENTRE** **ENDURE Information Centre (ENDURE IC)**
	Interactive

Date (09/03/2010)

WHAT IS…	The ENDURE Information Centre (ENDURE IC) is an interactive website which disseminates a European quality selection of validated Integrated Pest Management (IPM) measures. It is a central point of reference for extending expert knowledge, recommendations and advice for extension services, advisers, teachers, trainers and researchers concerning all aspects of IPM, including prevention and chemical pest and disease control as well as non-chemical alternatives such as biological control measures.
	ENDURE IC creates an overview of the ways sustainable crop protection can be implemented in European agriculture.
WHY	ENDURE IC provides advisers and farmers with knowledge on IPM based on a pan-European selection of national documents, summarised in English.
	Users can **search** for a combination of crop-pest/disease-control measures and select information about a given problem from different European countries. The results provided are ready to use, this means scientifically sound, tested in the field, practical to adopt and cost-effective. Furthermore, experimental results, which have the potential to provide a solution for a given problem but cannot yet be recommended as best practice, are also provided.
	ENDURE IC enhances the cross-fertilisation and possible adoption or adaptation of different national approaches in pest and disease control.
HOW	When preparing a **training session for regional problems** search ENDURE IC and find solutions used in other countries. Examine the results and check the sources, and if needed prepare more information from the original sources. In the follow up, scrutinise the applicability of the proposed measures labelled 'ready to use' for your region, and make adaptations which might be necessary for the farming system or region. Additionally use measures labelled 'experimental' as additional

	sources of knowledge.
	In your session with farmers you might discuss the options, adapted solutions and the **applicability of knowledge from different regions** and possible restrictions as well as the added value of increased accessibility of information on IPM in Europe.
	In a **training session for advisers** you can use the ENDURE IC for an 'Info hunt' (see Methodology sheet):
	1. Select an example together with the group (for example, Integrated Weed Management in Orchards).
	2. Each adviser works on keywords, and makes their own search in the ENDURE IC.
	3. Analyse the results of all the participants: documents found, the need for new searches with refined keywords.
	4. Each adviser has to give a summary (key points, highlights) on the topic with main conclusions and sources.
	5. You make a comparison of each summary and write/discuss the main ideas of the summary in the group.
SOURCES	http://www.endureinformationcentre.eu

TOOLS T 2	EuroWheat
	Home Project information ▾ Pathogens ▾ Fungicides ▾ Cultivars ▾ Wheat IPM ▾ Public documents
	Interactive

Date (09/03/2010)

WHAT IS…	EuroWheat is an **internet-based platform** which collates and displays **host/pathogen characteristics and pesticide efficacy** on a European scale. It brings together existing information from national programmes and ensures this data is in a format which can be readily understood trans-nationally by advisers and farmers. New disease and resistance data are published on the platform to support effective disease control, deployment of host resistances and breeding programmes.
WHY	EuroWheat assists advisers with **disease management practices** by providing information on key diseases based on current data of host-pathogen characteristics and pesticide efficacy in the EU. The platform provides data and overviews from Denmark, France, Germany, Poland and the UK on: ► The authorisation of fungicides and national trade names ► Information on efficacy levels and resistance ► Pathotypes and pathotype frequency ► Cultivar ranking and susceptibility ► Yield responses to fungicides ► The impact of cultural practices on disease development and disease management. In **IPM programmes** cultural methods, monitoring and decision support are essential tools for decision making. Cultural methods that have an impact on selected diseases are provided as well as methods for monitoring and control thresholds from different countries. An overview and links to Decision Support Systems are provided. The pan-European collection facilitates the understanding of disease epidemics, monitoring methods and the impacts of cultural methods on diseases.
HOW	EuroWheat is a source of information for advisers who want to know more about **disease control in wheat in other European countries**. Combined with valuable information

	about thresholds, status of resistance and much more, EuroWheat provides the adviser with an excellent opportunity to stay on top of potential problems in the growing of winter wheat.
	When hosting a **course in IPM**, EuroWheat may be used in two ways:
	► As a source for background information for the course (for example, a course in applied disease control in wheat).
	► As the main focus of the course: in this case, prepare an introduction about EuroWheat and questions to guide people using the database.
	The EuroWheat guide offers details about the different topics covered by EuroWheat.
	For the specialist adviser, the information in EuroWheat supports decisions for appropriate and effective IPM management practices in winter wheat.
SOURCES	http://www.eurowheat.org http://www.endure-network.eu/about_endure/all_the_news/eurowheat_download_the_guide

TOOLS T 3	EuroBlight A potato late blight network for Europe **EUROBLIGHT**
	Interactive

Date (25/10/2010)

WHAT IS…	EUROBLIGHT is a network of scientists and advisers working with potato late blight (*Phytophthora infestans*). The website www.euroblight.net serves as the common platform for the network and is open to everyone.
WHY	Although potato is a major crop in Europe, there are only a few people with in-depth knowledge about potato late blight. In order to promote research and IPM of late blight, this network was established as a part of the ENDURE network.
HOW	The homepage has a lot of late blight tools to offer advisers and farmers working with potatoes. These tools include: ► In-season **monitoring** of the fungus in northern Europe ► Comparison of **fungicide effects** ► **Cultivars** and their **resistance** towards late blight ► Information on **IPM practice** in potatoes ► Links to **publications** about late blight, including proceedings from late blight conferences and workshops ► Contact information on national experts in most European countries. Present the homepage to the participants of the training session, or use it to update your own knowledge before hosting a meeting on late blight. It could also be relevant to present the various Decision Support Systems to the participants, an essential part of IPM in potatoes.
SOURCES	For more information visit the official EUROBLIGHT website: www.euroblight.net Four leaflets have also been produced by the ENDURE network (also available in German and French and with Dutch summaries): 1: Reducing primary inoculum sources of late blight 2: Using Decision Support Systems to combat late blight 3: Fungicides for tackling late blight 4: Using cultivar resistance to reduce inputs against late blight Find them on www.endure-network.eu. A lot more information on late blight and other diseases in potatoes is also available on the ENDURE Information Centre, http://www.endureinformationcentre.eu/.

TOOLS T 4	IOBC Guidelines and Tools
	Interactive

Date (29/07/2010)

WHAT IS…	IOBC stands for International Organisation for the Biological and Integrated Control of Noxious Animals and Plants. It is a non-governmental scientific organisation, whose aim is promoting the use of sustainable, environmentally safe, economically feasible, and socially acceptable control methods for agricultural and forest pests. It is organised in geographic areas; Europe and Northern Africa are covered by the West and the East Paleartic Regional Sections. Members may be individuals or organisations. Its Working Groups are platforms for the presentation and discussion of sustainable crop protection. As part of its activities, IOBC has produced Guidelines for Integrated Production, which include IPM and have been the basis of the European legislation, and tools to facilitate the implementation of IPM in practice. Two Guidelines documents (I and II) summarise the aspects that apply to all crops, while another series (III) is crop specific. The tools include, for example, a database on the toxicity of pesticides to natural enemies.
WHY	The IOBC Guidelines and tools provide useful information to explain what IPM is, its main principles, and, more importantly for a training course, useful information for IPM implementation. They have been produced after thorough discussions by many scientists and practitioners in several meetings.
HOW	The IOBC Guidelines can be used as supporting material in the training sessions, in particular: ► Guidelines I and II: to explain IPM concept and principles. ► Crop specific Guidelines (III): to explain the application of the principles to specific crops, the importance of key natural enemies, or the criteria for selecting pesticides. The tools can be used as elements for the discussion: ► Green and Yellow Lists of Plant Protection Measures, a much broader concept than the Green and Yellow lists of pesticides. ► IOBC Database on Selectivity of Pesticides, a source of information on the toxicity of pesticides to selected natural enemies. ► SESAME: IOBC Inspection Protocol and its multifunctional software.
SOURCES	IOBCwprs homepage: http://www.iobc-wprs.org/ All the IOBC Guidelines and tools can be downloaded from http://www.iobc-wprs.org/ip_ipm/index.html Boller, E.F.; van Lenteren, J.C.; Delucchi, V. (Eds). 2006. IOBC: History of the first 50 years (1956-2006).

TOOLS T 5	Identification of natural enemies
	Theoretical

Date (11/08/2010)

WHAT IS…	Pests are species (in this sheet we are focusing on arthropod species) feeding on plants (herbivore species), while natural enemies (beneficial organisms) are species destroying these pests in agricultural fields. Natural enemies can be divided into two groups: predators and parasitoids. Predators (ladybirds, for example) are organisms that feed on the pest, while parasitoids (Trichogramma wasps, for example) are organisms that lives on or in the pest. Natural enemies are species which can hold the population of the pests under a threshold level. Due to this fact, support and conservation of natural enemies is a key point in Integrated Pest Management and, moreover, is part of Integrated Farming. Farmers should understand the role and lifecycle of natural enemies as a part of an IPM strategy. Moreover, farmers have to take into consideration biodiversity (pests, natural enemies) and number and role of different natural enemies while making decisions on further management options in the field. Decision making has to be made based on a sound understanding of the agro-ecosystem and based on the current situation in the field.
WHY	Natural enemies destroy pests and therefore decrease the damage caused by these pests. Most people can recognise only a few natural enemies. However, more than 1,000 species have been identified in agricultural fields and only a small percentage are pests. During the decision making process, farmers have to take into account the population level of natural enemies, and the impact of a given management option (insecticide application, for example) on the population level of natural enemies and pests. If insecticide application is unavoidable, insecticides have to be chosen after consideration of their impact on natural enemies and beneficial organisms (bees, for example). To be able to make a decision based on the current situation in the field farmers have to have the capacity to identify natural enemies and pests. Moreover, they must understand the relationship between these species and to take this into consideration during the decision making process. Learning to recognise and manage these natural enemies is a major focus of IPM training as it avoids their destruction through unnecessary applications of herbicides, insecticides and fungicides and allows them to work for the benefit of farmers.
HOW	Ideally, learning to identify natural enemies can be achieved through field visits, but in-hall training can also provide a good base for further learning. Meetings should include before and after discussions on natural enemies, since this is one key area for sound understanding and success. The methods listed below are ways of successfully teaching the identification of natural enemies to farmers.

	1. In-hall meetings **A.** Working with insect preparations ► Identification of insects, using a guide for identification ► Grouping of insects (beneficial organisms versus pests; Coleoptera versus Lepidoptera) using a guide for identification ► Microscope work with insects (to observe general differences in the morphology of pests and natural enemies) **B.** Set up an insect zoo ► Farmers can collect pests and beneficial organisms in the field. Putting these insects into jars or an insectarium, allows farmers to follow the behaviour of natural enemies and can help define the role of the species. **2. Field visits** ► Agro-ecosystem analyses by visual observation ► Collecting insects using different traps (pitfall traps, yellow sticky traps, etc) ► Net sweeping ► Collected insects can be observed, grouped and identified during in-hall meetings, or could be identified in the field by using guides and cards for identification of insect species.
SOURCES	► You can search material on the ENDURE Information Centre. Use the keywords: measure / training materials / identification of beneficials. ► http://www.ipmnet.org/Pocket_guide_of_Natural_Enemies.pdf ►http://www.inhs.illinois.edu/chf/outreach/eduresources/good/guysframes.htm

TOOLS T 6	Use of Biological Control
	Theoretical

Date (29/07/2010)

WHAT IS…	In its broader sense, biological control refers to the use of all kinds of natural enemies to maintain pest populations (animals, plant pathogens and weeds) below the economic injury level. In this sense, natural enemies include predators, parasitoids and parasites. Predators (ladybirds, phytoseids) are species which need to feed on more than one individual member of its prey to complete their development; both immature and adults are predators. The immature stages of parasitoids (parasitic wasps, tachinids) need to feed on only one individual of their host species to reach the adult stage; adults are free-living individuals. Parasites establish a continuous relation their hosts that produce negative effects on them, including death. They are microorganisms such as virus, bacteria and fungi, and animals, such as nematodes. Biological control can be used in several ways: importing and establishing exotic natural enemies (inoculation), rearing and releasing natural enemies (seasonal inoculation and inundation) or preserving naturally occurring species (conservation and augmentation). A special case are entomopathogenic microbes which can be used as microbial insecticides.
WHY	Biological control is one of the most important key elements of IPM, as it has no adverse effects on human health or pollution, and it might have only slight negative effects on the environment. Advisers and farmers must be very familiar with both the principles and implementation of biological controls.
HOW	**1. In classroom sessions:** ► Explain the concept of biological control, and of each natural enemy type. ► Explain the biological control techniques, illustrating them with examples from you own area, and with well known classical examples. **2. During field visits:** ► It is not easy to observe biological control 'in action', but if possible select a field where natural enemies (mobile predators, parasitized pests) can be seen. ► Plan a release of natural enemies in a classroom session, and then conduct this in the field. ► Return at a later date to check the results of the release.
SOURCES	► The UC Interactive Tutorial for Biological Control of Insects and Mites http://www.ipm.ucdavis.edu/IPMPROJECT/cdroms.html ► Driesche, R.G. van; Bellows Jr., T.S. 1996. Biological Control.

	Chapman and Hall.
	► On the ENDURE website:
	► In depth: Biological controls
	► Easing the way for biological controls
	► On the ENDURE Information Centre:
	Keywords: Measure > non-chemical control > biological control
	Keywords: measure > training material > identification of beneficials

TOOLS T 7	Landscape approach for IPM
	Theoretical

Date (17/08/2010)

WHAT IS…	The landscape approach is the consideration of the effects of some elements of the landscape on the success of Integrated Pest Management, as they can influence **conservation biological control**, the **spatial and temporal distribution** of animal pests and natural enemies, and the **biodiversity** that contributes to the long term stability and sustainability of agroecosystems
	These effects are due to **conservation biological control** (the spontaneous colonisation of fields by natural enemies), to the **pattern** of habitats (which influences distribution of both pests and natural enemies), and to the **biodiversity** (long term stability and sustainability).
	These large scale effects are dependant on the amount and the composition of species in non-cultivated areas and on the farming system intensity at regional level. **Non-cultivated areas** provide alternative habitats for both pests and natural enemies; however these are the main sources for biodiversity. **Farming system intensity** influences the amount of suitable habitats for pests, weeds, diseases and natural enemies based on the crop rotation and pest management intensity. Agronomic practices in the given region determine the amount of pests and natural enemies in the landscape, for example if maize is not usually rotated, the risk of western corn rootworm is larger; or if in practice no insecticide is sprayed in arable corps, the amount of natural enemies is larger in the landscape.
WHY	If farmers are aware of landscape effects in their own region, it helps to understand the effects coming from 'outside' their fields and to include them into their decisions. It enhances **common responsibility** for the presence of both pests and natural enemies in their region, and also for the level of biodiversity. This might enhance the implementation of EU policy to emphasise other functions of agriculture rather than the focus on production.
HOW	The landscape approach should be implemented as an element of IPM. After introducing the expected landscape effects in general, the adviser should refer to landscape relevancies by discussing the given IPM topic. Often there is no clear evidence for landscape effects, so the experience of the participants should be enhanced. In cases where they don't have any, the adviser should fire their interest and provide a tool-box to measure it.
	Some methods to help farmers to understand landscape and landscape approach:
	► Identification of landscape elements in the farmers' region that can influence the biological control of specific animal pests
	► Agroecosystem analyses of fields for different habitat patterns

	► Agroecosystem analyses of field margins for different habitat patterns ► Development of <u>participatory</u> plans on landscape expansion.
SOURCES	**ENDURE website** ► <u>Landscape ecology: the bigger picture</u>: ► <u>ENDURE Deliverables DR2.9</u> ► <u>ENDURE Deliverable 2.2</u> **IOBC** ► <u>Landscape management for functional biodiversity</u> **ENDURE Information Centre (www.endureinformationcentre.eu)** ► Keywords: Measure > habitat conditions *or* protection and enhancement of important beneficial organisms ► IOBC/WPRS Bulletin Vol. 26 (4), 2003, Vol. 29 (6) 2006, Vol. 34, 2008, 2010 (in press) ► Boller, E. F., Häni, F., Poehling, H-M (2004): Ecological infrastructures: ideabook on functional biodiversity at the farm level

TOOLS T 8	Agroecosystem analyses (AESA)
	Theoretical

Date (25/07/2010)

WHAT IS	An ecosystem is a natural system based on interactions of biotic and abiotic elements. It is an open system which nevertheless has some self-regulation capacity. If this ecosystem includes crops, we call it an agroecosystem. An agroecosystem is based on ecological interactions between the environment, plants (cultivated and non-cultivated), herbivores (invertebrates - mainly insects - and vertebrates), plant pathogens, and natural enemies of herbivores (parasites, parasitoids and predators). The health of the plant is determined by the environment (weather, soil, nutrients) and the herbivores. The populations of herbivores are balanced by their natural enemies. Weed plants in the field, with which the crop has to compete, also have an effect on crop condition and health. To be able to understand how this system is working, one should know the elements of it and the interactions among them. This aim can be reached by Agroecosystem Analyses (AESA).
WHY	The goal of AESA is to assess what type of action will be needed to best produce a profit for the farmer.
HOW	AESA should be conducted by observing biotic and abiotic elements of the field, flowering field edges and the surroundings of the field. Sampling of a few locations in the field allows us to estimate and to understand what is happening in the whole field. Observations are made at each location of: ► Date, type of study field assessed, number of days/weeks after sowing (age of crop) ► Soil conditions ► Weather conditions ► Plant development: plant height, and the size and number of leaves, ears etc. ► Plant health status, based on leaf colour (nutrient deficiency symptoms), etc. ► Pest and disease attack symptoms, number and types of pests and natural enemies ► Presence of insect pests in the soil ► Presence of insects living on the soil (Barber pots/pitfall traps) ► Weed incidence ► Environmental conditions around the field ► Unknown insects, leaves with an unfamiliar appearance, with

	symptoms of unknown diseases, insect damage, or with other damage
	AESA will be successful if it is done regularly (every two to three weeks) and throughout the season. With this intensity, farmers will have continuous information on what happens in the field and what interactions are needed.
SOURCES	Frederike Praasterink: A facilitator's field guide.

TOOLS T 9	Use of semiochemicals
	Theoretical

Date (29/07/2010)

WHAT IS…	A semiochemical is a chemical substance which is involved in communication between organisms. When the releaser and the receiver belong to different species, the substance is called an allelochemical. If the action of the allelochemical benefits only the releaser (i.e. it works as a repellent) it is called an allomone. If it benefits only the receiver (i.e. an attractant), it is called a kairomone. When the releaser and the receiver belong to the same species, the substance is called a pheromone (i.e. sex pheromones, substances involved in communication between individuals of different sexes). Their use in IPM is based on the disruption of the behaviour of animal pests that they may cause. Some substances of non-living origin, which are therefore not true semiochemicals, can be also used in a similar way. They are known under the generic names of attractants or repellents.
WHY	In general, semiochemicals can be synthesised in the laboratory at reasonably high scales and costs, making it possible to use them in IPM. Kairomones and particularly pheromones are widely used for population sampling (using either the complete pheromone or just its main component), and as part of control techniques, such as mating disruption, mass trapping, attract and kill, and attract and sterilise. In the case of population sampling, it is important that advisers and farmers can correctly interpret the results of catches in widely used pheromone traps.
HOW	**In classroom sessions:** ► Explain the concept of the different types of semiochemicals. ► Present the different control techniques that use semiochemicals. ► Focus on the practical aspects: conservation and handling of traps and dispensers, placement and distribution of traps and attraction units in the field, and checking procedures. Wrong use of these devices may lead to wrong pest control decisions. **In practical lectures:** ► Show different traps and dispensers, and allow participants to handle them. **During field visits:** ► Plan a visit to a plot where the method is applied.
SOURCES	► The Pherobase: http://www.pherobase.com/ ► On the ENDURE Information Centre: Keywords: measure > non-chemical control > biotechnical measures

TOOLS T 10	Pest and natural enemy monitoring / Population sampling
	Theoretical

Date (29/07/2010)

WHAT IS…	Population sampling is the collective name for activities conducted to estimate the population density of a given species (an animal pest, a plant pathogen, a weed or a natural enemy) in a given habitat (the plot where the crop is grown). Plant pathogens are a special case, as generally it is not the population density, but the intensity of the disease that is estimated. The final goal may be to compare the pest population with the economic threshold in order to decide whether it is necessary to apply a control measure, to decide whether a pest control measure has been effective, or to decide whether a natural enemy is providing successful biological control. Population sampling is carried out accordingly to a sampling programme, which is the precise procedure followed to take the sample from the plot, and to process it using a sampling technique. Sampling programmes must be reliable, but also practical in terms of time and cost.
WHY	It is impossible to apply IPM without knowing the population density of pests and natural enemies in the plot, as the economic injury level is its cornerstone. As population monitoring is time consuming, the extension of IPM needs an increasing commitment from growers in this activity. The correct application of the sampling programme by advisers or growers is essential to produce reliable results and, consequently, to avoid making wrong decisions.
HOW	Population sampling is highly crop and pest dependent, so it will be difficult to explain in detail all the sampling techniques. It is better to focus on a small group of crops. On the other hand, it is an activity very suitable for demonstration in the field. **In classroom sessions:** ► Explain the concept of population sampling and stress its importance. ► Present and discuss ready-to-use sampling programmes. **During field visits:** ► Prepare a collection of sampling techniques (traps will probably form an important part). ► Carry out visual sampling, individually or in groups. ► Discuss the results, focusing on their possible variability and stressing the importance of doing it right.
SOURCES	► University of California IPM Manual Series: http://www.ipm.ucdavis.edu/IPMPROJECT/pubs.html ► On the ENDURE Information Centre: Keywords: measure > decision support / control > monitoring

Food Quality and Safety
6TH FRAMEWORK
PROGRAMME

TOOLS T 11	DSS (Decisions Support Systems)
	Theoretical

Date (26/05/2010)

WHAT IS…	Decision Support Systems (DSSs) are - almost exclusively – computer-based data processing mechanisms where the end-user has to 'feed' the system with appropriate input data. In response, the computer returns the results of its own calculations, which should be useful in the decision making process in pest control (or elsewhere). Remember, **COMPUTERS NEVER THINK!** The usefulness (or complete uselessness) of DSS depends on two factors: the quality of input data and the quality of the background algorithms. The first factor depends on the end-user, whereas the second is the responsibility of the program developer.
WHY	DSS can act as an important tool for making 'good decisions'. For a long time 'good decisions' in farm management (and in pest control) equalled 'economic decisions' - to be more cost-effective and raise profitability was one of the main reasons for the creation of DSS. However, these days more attention is focused on the incorporation of additional (strategic) aspects besides the original (tactical) ones. Such strategic aspects can be diverse, from taking resistance management into account, to the consideration of influence of pesticide applications on non-target organisms. In general, the competence of DSS has increased. The development of information technology points towards the integration of different tasks into a complex and in most cases web-based computer service for farmers. Such a platform can serve as a comfortable, fast and reliable aid in everyday decision making in pest control as well as in managing more general farm administration tasks. You may be confronted by a reluctance to accept DSS - these tools are meant to raise competitiveness but their use is not essential. Nevertheless when farmers, directly or indirectly, have to compete in a global market environment, it is questionable if they can stay competitive in the long term if they refuse to implement new

	technologies.
HOW	Basically there are two main streams of DSS co-existing: ► Some focus on one or just a few crop/pest systems. In many cases these computer programs are available on the market as CD-ROMs and/or are the property of an organisation providing advice for farmers. The opposite end is the complex web-based service covering many crop/pest systems. In the latter case, the end-user pays a regular fee for access to the service on an internet platform. ► In most cases all types of input data that can be extracted by an automated procedure, such as records of weather stations and several internet databases, are put into the system independently from the end-user. However, the end-user has to 'hand-feed' the system with at least some of the input data, that which is specific to their farming practice. ► System outputs can be diverse and they are in many cases up to the choice of the end-user: email alert, sms alert, regular expert analysis etc.
SOURCES	ENDURE WEBSITE http://www.endure-network.eu/endure_publications/deliverables: DI 2.4 : **Review (hard-copy and electronic) of new technologies critical to effective implementation of DSS and FMS** http://www.endure-network.eu/about_endure/all_the_news/online_analysis_of_late_blight_dss: **On-line analysis of late blight DSS** http://www.endure-network.eu/about_endure/all_the_news/dss_helping_farmers_make_smart_decisions: **DSS: helping farmers make smart decisions** ENDURE INFORMATION CENTRE http://www.endureinformationcentre.eu → key words: Measures > Decision support / Control > Decision support systems

TOOLS	Use of resistant/tolerant varieties
T 12	
	Systems

Date (15/09/2010)

WHAT IS…	Different varieties of different crops have different levels of tolerance towards attack by pests and diseases. If a variety is not affected by an attack at all, it is said to be resistant towards this pest or disease.
WHY	The use of resistant or tolerant varieties is one of the cornerstones of Integrated Pest Management (IPM). By always using the most tolerant variety, the use of pesticides may be kept at a minimum. It is however very important to remember, that the level of tolerance may shift over time as, for example, the disease population also adapts. Varieties that might have been resistant or very tolerant to mildew (*Blumeria spp.*), for example, for several years may over a short period of time show significant increases in attack. Therefore, it is also important to monitor and test the varieties annually, to try to forecast the development in tolerance.
HOW	The key to success is to choose varieties which are competitive from an economic point of view, while at the same time showing a low susceptibility towards the important pests and diseases. Therefore, whenever a choice of variety has to be made, search relevant databases or similar for information on the properties of specific varieties (see Sources). The table below shows nine of the most important winter wheat varieties in Denmark (all figures in euro/hectare):

Variety	Gross yield	Net yield	Cost fungicides, incl. application
Hereford	950.34	848.59	50.47
Oakley	945.91	824.30	70.34
Conqueror	932.08	816.38	64.43
Mariboss	927.52	818.79	57.45
Frument	925.23	813.83	60.13
Timaru	913.83	819.73	42.82
Ambition	909.26	797.72	60.27
Alfaromero	905.91	801.21	53.42
Tuareg	881.88	761.61	68.99

The table gives an insight into the dilemma that the farmer is facing when choosing a variety. The variety with the highest yield potential (Hereford) is also the variety that gives the highest yield when subtracting the costs of seeds, fungicides, extra N fertiliser etc. (Net

	yield). It is, however, not the variety which is cheapest to control diseases in. This is the variety Timaru. And even though Timaru shows low susceptibility towards diseases, it is not able to compete with the yield potential of Hereford. The opportunities for marketing are also important parameters for choice of variety. This is, for example, relevant for production of bread or fodder wheat.

What I have to do	Choose winter cereal variety based on the following:
	  1. Winter hardiness
	  2. Use (for example, bread or fodder)
	  3. Yield potential
	  4. Risk of lodging
	  5. Tolerance towards important diseases and pests
	This prioritised list will of course depend on the crop and region.
	In a training session, these tables may form the basis for a discussion with a group of farmers or advisers. For this, you can use the ENDURE documents (see Sources) or any local document about varieties and use it during a training session using participatory methods (see Methodology).

SOURCES	For information about the varieties in Europe in winter wheat or potato, see: ► http://www.eurowheat.org/EuroWheat.asp ► http://www.euroblight.net/EuroBlight.asp For information (in English) about the varieties of different crops available in Denmark, see: ► http://www.sortinfo.dk/Oversigt.asp?Sprog=uk For information (in French) about the varieties of different crops available in France, see: ► For oil-seed crops: http://www.cetiom.fr/index.php?id=2260 ► For sugarbeet: http://www.institut-betterave.asso.fr/