![SCAR - Standing Committee on Agricultural Research]

- Report -

SURVEY
ON PEST MONITORING SYSTEMS ACROSS EUROPE
within the realm of integrated pest management
from the SCAR CWG on IPM

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Content

Glossar

DSS: Decision Support System

Ecophyto: The French National Action Plan

IPM: Integrated Pest Management

MS: Member States

NAP: National Action Plan

Pests: collectively refers to animal pests, weeds and diseases

PPP: Plant Protection Products

Country abbreviations

AT: Austria

BE: Belgium

BG: Bulgaria

CH: Switzerland

CY: Cyprus

CZ: Czech Republic

DE: Germany

DK: Denmark

EE: Estonia

EL: Greece

ES: Spain

FI: Finland

FR: France

HU: Hungary

IE: Ireland

IT: Italy

LT: Lithuania

LU: Luxembourg

LV: Latvia

MT: Malta

NL: Netherland

NO: Norway

PL: Poland

PT: Portugal

RO: Romania

SE: Sweden

SI: Slovenia

SK: Slovakia

TR: Turkey

UK: United Kingdom

1 Context

In early 2011, the French Ministries of Agriculture and Research proposed the creation of a Collaborative Working Group (CWG) on Integrated Pest Management (IPM) under the Standing Committee on Agricultural Research (SCAR). The goal of the CWG is to address a number of plant protection research and development challenges that are best tackled at the European level. More specifically, the CWG provides a European forum for exchange and identification of joint research and development priorities to, taking into consideration the potential of new areas of research and innovation. As in accordance with Directive 2009/128/EC Member States are developing National Action Plans (NAPs) and will need to facilitate the development and implementation of integrated pest management (Art. 14 and Annex III) the CWG offered the opportunity to identify, plan and share joint research and development initiatives. Representatives from 17 EU Member States and Associated Countries joined the new CWG entitled "Integrated Pest Management for the reduction of pesticide risks and use" which was launched in May 2011 to provide recommendations on research needs to the EC's DG Research and Innovation and to Member and Associated States.

The "Collaborative Working Group on integrated pest management for the reduction of pesticide risks and use" conducted a survey on pest monitoring systems within the realm of integrated pest management (IPM). It complements the survey of plant protection policies and associated research and extension relevant to IPM, which was conducted in 2012 and published as the report "Analysis of research and extension needs for the development of IPM. Final report of a survey conducted among European countries by the SCAR CWG"[1].

1.1 Goal of survey

The goal of this Europe-wide survey is to map out the current situation on pest monitoring systems (PMS) for integrated pest management. PMS integrate a wide range of domains, from forecast and monitoring of pests and diseases, warning and alert systems to scouting thresholds and advisory services on integrated pest management. It also covers a wide range of players including farmers, advisors, scouts, government representatives, industry, researcher etc. In this respect pest monitoring systems are not limited to computer-based systems but comprise initiatives, networks, activities, tools etc. that assist farmers in taking the right decision in integrated pest control.

The three major components of PMS and their interlinks are in the focus of this survey:

In-field monitoring/surveillance/scouting: Up-to-date and periodic in-field monitoring/ surveillance/scouting of weeds, pests and diseases;

Decision support systems: Alert systems, simulation and forecasting systems which help famers to identify monitor and control weeds, pests and diseases;

Pest warning services by extension services/advisors: Specific advice from independent extension services/advisors. The advice is generally based on individual professional working

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[1] http://www.endure-network.eu/about_endure/all_the_news/priority_ipm_research_needs_identified

experience and the interpretation of up-to-date DSS outcomes and monitoring/surveillance/scouting results.

The outcome of the survey will serve to identify what research and development is needed to support PMS, assess the added value and opportunity of jointly addressing needs and finally, make recommendations on cross-national initiatives. By inviting Member States and Associated States to contribute to this survey, the CWG expects to draw a picture at European level of the various national PMS and the variety of approaches, technologies, outcomes and experiences. Targeted collaboration and networking of PMS at supra-national level can certainly provide benefit and stimulation for EU and national oriented research.

1.2   Credits

Part B of the questionnaire builds on work, experiences and results of the European Network for the Durable Exploitation of Crop Protection Strategies (ENDURE) who conducted an extensive survey on Decision Support Systems (DSS) and Farm Management Systems[2] (FMS) in the year 2007. The report "Review of new technologies critical to effective implementation of decision support systems and farm management systems"[3] summarised and analysed the survey results. The report identified the best parts of DSS with a view to a potential unification and the construction of operational DSS prototypes. Although it was recognised as a huge project and estimated to take decades the first steps were taken by identifying those building blocks such as modelling approaches, IT-structures etc. The first results can serve as a starting point for future joint national collaborations.

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[2] In the following report referred to as ENDURE DSS/FMS 2007 survey

[3] http://www.endure-network.eu/about_endure/all_the_news/dss_helping_farmers_make_smart_decisions

2 Introduction

In the course of work of the CWG it was proposed by Germany to newly conduct a survey on pest monitoring systems. The aim of the survey was to update available information on pest monitoring systems (PMS) and decision support systems (DSS) which were surveyed in the work of the NoE ENDURE and published as "Review of new technologies critical to effective implementation of Decision Support Systems (DSS's) and Farm Management Systems (FMS's)" (2009), collect the missing information from countries which were not part of ENDURE but participate in the CWG. Furthermore, the scope of the survey was expanded to verify whether existing PMS are suitable for cross-border use and to explore the potential for joint national collaborations.

The survey questionnaire was developed by a core group from DE and FR and comprised of 2 parts. Part A collected background information about the organisational set up of PMS in 3 main questions with 3-5 sub-questions. Part B was based on the ENDURE survey "Form for collection of data on DSS's for crop protection in EU-countries and Switzerland" with a number of modifications made by the core group. The parts of survey questionnaire:

Part A - Background information on PMS

- Actions of in-field monitoring/surveillance/scouting
- Decision making tools for the implementation of IPM
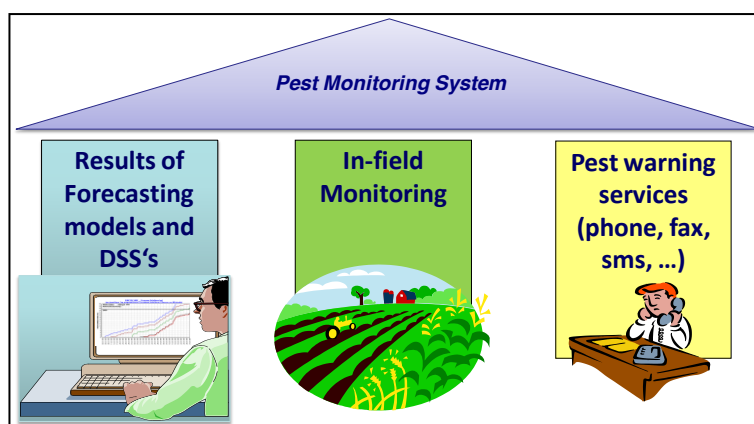- Pest warning services used by extension services/advisors

Figure 1: Components of Pest Monitoring Systems

Part B - Collection of technical data on DSSs for crop protection

- Basic attributes and features
- Models used
- Dissemination, impact and potential for integration
- Technical parameters (updates, unification, feedback functions)
- Annex concerning the cross-border use and spatial data issues

The full survey (see Annex) was sent out in March 2012 to national contact persons for the Sustainable Use Directive (2009/128/EC), SCAR CWG participants and SCAR representatives of Associated States.

By summer 2012, 13 national responses (BE, CZ, DE, EE, FI, FR, IE, NL, PL, PT, SE, TK, UK) were received for the survey part A and only 7 responses (BE, CZ, DE, FI, NL, PL, SE) were received for part B of the survey. The quality of the responses varied and is based on the knowledge and information provided by the individual respondents. Therefore, it does not necessarily reflect the national view. The few answers for the survey part B, indicate that although according to the ENDURE review much more information is available, the answers required detailed technical information which seemed not to be at hand for the respondents. Therefore, it was discussed and concluded in the CWG that this might be a subject to be referred to and further investigated by national experts.

3 Questionnaire Part A: Background information on PMS

To the reader: The order of presented results in the report does not follow the order of questions in the survey. The results were re-organised in order to achieve a coherent report.

3.1 Current situation and planned activities within national crop protection policies which address the in-field monitoring/surveillance/scouting for the implementation of IPM

National crop protection policies exist in a number of countries (BE, CZ, DE, FI, IE, PL, SE, TK) and target crop protection in general (at the time of the survey) and are mainly coordinated by governments or organisations organised at the state level. The reference to IPM is not always made but existing systems are one of the IPM elements and it is assumed that pre-existing systems on major pests and diseases and are now (to be) included in support of IPM implementation in NAP.

In Ireland, elements of IPM such as disease control programs, including exploiting plant resistance, monitoring key pathogen sensitivity/resistance development and developing effective disease control programs, are key objectives of the research and extension organisation.

In Poland, monitoring tasks are part of the multi-year research program.

The supervision of pest monitoring systems and evaluation is mostly in responsibility of governmental institutions (CZ, DE, NL, PL, SE, TK) in cooperation and support by national stakeholders such as boards of agriculture, national and regional advisory services and research institutions. In some countries (BE, EE, FI, DE, SE) research institutes and advisory organisations (IE) fulfilling the role of running statutory monitoring activities, the development of efficient pest and disease monitoring tools and techniques, and research activities related to PMS. Budgets are mainly allocated by national funding. In the UK, the government sets the overall frame but the organisation of plant protection, and PMS in particular, is the role of the different players in the agricultural sector mainly based on voluntary and assurance schemes.

3.2 National crop protection policies which address the use of DSS and the organisational structures to develop, maintain and evaluate the use, outcomes and quality of DSS

Mostly governmental institutions oversee and in some countries supervise and fund the development of DSS (CZ, DE, EE, PL, SE, TK). In many other countries (FI, IE, NL, SE, UK) the development and maintenance of DSS is mainly in the responsibility of the different sectors (industry) or grower associations, research or it is supported by other measures such as AES (PT). CZ and PL plan to develop or adapt additional DSS in the framework of the SUD (Directive 128/2009/EC).

The evaluation, quality assessment and further development of DSS is mostly in the responsibility of research organisations (DE, EE, PL, SE, UK). In other countries extension services and growers are involved (IE, NL); in PL and TK the evaluation of the system is in the responsibility of the government. For the maintenance and development of DSS exist diverse funding sources in the different countries. For example, in the Netherlands DSS for crops with very high pesticide use were funded with public money whereas, other DSS are funded by private and public sources. In Portugal, the implementation of integrated production, requiring the mandatory use of decision support tools, is funded under agri-environmental schemes and in Poland, research institutes develop and adopt DSS as statutory tasks and part of the multi-year research program which is approved by the government. In the UK the actors which develop DSS are also responsible for the funding.

3.2.1 Systems for in-field monitoring/surveillance/scouting

National pest monitoring activities and DSS exist for key pests and diseases in the majority of countries. In some countries (FI, SE) DSS tools and measures are developed and implemented in dedicated research programs.

Monitoring programs are mainly carried out by advisory services under supervision or as statutory tasks of national institutions.

In IE, a formal (governmental) framework monitoring does not exist; it is carried out mostly by advisory services/regional groups. Research and advisory services cooperate and the monitoring results are included in the pesticide use recommendations. Key diseases mentioned were: potato late blight, blackleg and soft rot on potato, pests, disease and weeds of oilseed crops, aphids as virus vectors, cereal pests (Wheat Bulb Fly, Saddle Gall Midge, Wheat Blossom Midge and Leatherjackets), cereal rusts and mildews and quarantine pests.

Monitoring pesticide resistance is part of nationally funded programs which are run and funded nationally (DE, IE, PL), research (DE, FI, PL, SE, UK) or extension services (DE, IE, SE, PL, TK, UK, in the national and international resistance action committees (NORBARAG, FRAC, HRAC) and (pesticide) industry.

Pesticide use data are collected at the level of plant protection authorities (BE, CZ, DE, NL, SE, TK, UK). Additional data on pesticide use, concerning major crops which cover more than 75% of the agricultural area, will be made available with the Regulation (EC) No 1185/2009 concerning statistics on pesticides. Some countries collect pesticide sales data (FI, NL). The value and suitability of such highly aggregated data depends on the assessment purposes.

The non-intentional effects of pesticide use are monitored mainly concerning human health issues and effects on non-target organisms in CZ, DE, FR, NL, PL, UK; residues in ground water are monitored in DE, IE, NL, PL, SE. In Germany and Ireland, residues in food and feed are monitored regularly and PL sets up a monitoring system for bee poisoning.

Systems for monitoring biodiversity include mainly activities steered by environmental institutions and research in dedicated projects which include very few monitoring activities on field level (CZ, DE, EE, FI, IE, SE, UK). France started monitoring the effects of different farming strategies 2012. Finland conducted extensive surveys of weeds in spring cereals since the 1960s, with the latest survey comparing conventional and ecological cereal production in 2007-2009. In the UK, the Environmental Change Network is in place which collects information about the pressures on and responses to environmental change in physical, chemical and biological systems funded by public and research organisations.

Surveillance activities concerning GM crops are run only by a few countries due to the fact that most countries do not allow cultivating GM crops. In CZ, the biological efficacy of Bt. maize and co-existence measures are monitored. IE and SE conduct a few trials and projects with GMOs. The UK Government is beginning to look at how existing environmental surveillance networks might be used as part of post market environmental monitoring of GM crops.

In most countries (CZ, DE, EE, FR, IE, NL, PL, PT, SE, UK) monitoring activities in the responsibility of national institutions exist for **invasive alien species** mainly monitoring the occurrence of quarantine pests.

3.3 The roles, organisation and types of advisory systems within national crop protection policies for the implementation of integrated pest management

The organisational structure and assigned tasks of advisory systems vary greatly between the respondents and across Europe. Over the last 20 years, a trend to privatise formerly state funded advisory services can be observed in many European countries. The respondents inform that farm advisory services exist and address IPM implementation in BE, CZ, DE, FR, IE, NL, PL, PT, SE, TK and UK. However the organisational structure varies, for example in CZ, nationally accredited advisory service is organised within the schemes of EAFRD[4] under the auspices of the Czech Ministry of Agriculture; in DE and PT, state advisory services exist to support the implementation of IPM or are under development (PL). In CZ, the scheme includes three groups of advisors for agriculture, forestry and plant health. The activities cover advice for the government, research and technical advice for agricultural producers and distributors of pesticides. The state plant health advice provides information about plant protection products, develops the lists of approved pesticides and sprayers. Seasonal information about the development of major pests and diseases is the pivotal role of all advisory services. In PL, one main elements of the new NAP is to train the trainers and to provide the advisors with appropriate tools, develop IPM guidelines and provide the information via a website. Those tasks are conducted jointly and coordinated with research institutes. Websites and internet tools are the major component for dissemination of information and advice (DE, EE, FI, FR, SE, UK). The state advisory bodies in CZ also approve

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[4] Council Regulation (EC) No 74/2009 amending Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

and make available the new plant protection guidelines which are developed by research. In many countries the advisory services usually cover also tasks beyond crop protection advice and planning such as certification and issues of the common agricultural policy or other regulations (CZ, NL, UK). The following websites with partially free access to DSS were mentioned: in DE, ISIP.de is a portal which offers general information on plant protection and seasonal information of the development of the key pests and diseases. The website covers the main crops, provides data on pest and disease occurrence based on prognosis system and forecasting models which are based on local meteorological data. In EE, I-Plant Protection is a web-based system for disease and weed control. Based on registration of field data it provides information about the optimal dose of plant protection products. The French IPM website, "EcophytoPIC, le portail de la protection intégrée des cultures" (PIC equals IPM in French) is a tool to provide information about IPM to different agricultural stakeholders. The website is designed as a central reference point, acting as a gateway to all sources of information relating to Ecophyto 2018. The UK response mentioned the Defra-Farming Advice Service (FAS); it combines the Cross Compliance Advice Programme with farm advice on nutrient management, competitiveness, climate change adaptation and mitigation.

3.4 Do networks of PMS exist where advisory/extension services share or assess the outcomes of DSS and monitoring?

Most countries don't have formal networks of PMS, regional services are used but not necessarily linked or to assess the outcomes of DSS and monitoring. However, the situation is different in other domains for example, PMS networks on national level and cross-border networks exist in the plant health sector and for quarantine organisms or invasive alien species. Concerning crop protection and IPM in particular some respondents (DE, IE, SE) indicate that mechanisms for the evaluation of results and for feed back exist, presumably as regular procedure of work. In FR, the government funds a large nation-wide pest monitoring network and monitoring programme. The outcomes of those monitoring activities result in a weekly bulletin called *'Bulletin de Santé du Végétale'* (BSV), which offers information on the pest situation and the applicable control thresholds. CZ plans to set up a process to interlink farmer demands concerning DSS to the state PMS.

3.5 Benefits and bottlenecks for cross-border use of DSS

Cross–border use of DSS is considered useful by most of the respondents (CZ, DE, EE (only IT-tools), FI, NL, IE, PL, PT, SE, UK) and is already practiced in a number of cases (e.g VETAB, ProPlant, NegFry, RIMpro, DSS Herbicide, I-plant Protection). The exchange and adaptation of models is recognised as an opportunity for the efficient use of resources with shrinking national public budgets and human resources.

However, it is acknowledged that such cross border use currently seems mainly possible as an exchange of IT tools, architecture and technologies and a requires an adaptation to the regional conditions (EE, FI, NL, IE). Respondents (CZ, EE, FI, IE, PL, PT) mention that the development models/algorithms for pest and/or disease biology vary across regions due to the different climatic conditions. Consequently, this is identified as a bottleneck for the immediate adoption across regions. Further investigations are necessary to scrutinize

existing DSS and DSS which are already used in different regions concerning their dependence on regional input parameters. DSS which do not rely on the regional parameters could be scrutinized for their application in different regions.

Additionally to the issues of adaptation, intellectual property rights and private or institutional ownership for some DSS are obstacles for cross- border applications (CZ, PL).

3.6   Potential for collaboration

Considering that there is a high demand to improve monitoring and decision making, and that many emerging systems are already in place, this is probably one of the areas most ready for joint actions.

DSS deliver important information and support the short term decision making for farmers during the season. Systems for the in-season monitoring of key pests are in place in most countries and widely used by advisory services and farmers. Decisions about the development of new PMS are based on the potential economic damage of individual pests. The development of PMS requires immense resources which is one of the reasons that DSS are only developed for the most damaging pests. The definition of robust treatment thresholds and their suitability to local climatic conditions are considered as the most important elements in DSS and forecasting system development. Thus, benefits can be created by sharing systems based on a common ontology between countries or regions and for pests which currently occur rarely or below economic damage thresholds but are anticipated to become more damaging in the future (e.g. due to climate change or development of pathogen resistance).

Additionally, according to the responses it seems not a common practice to enable links by using a standard ontology and collating the data in harmonized formats that their exploitation and exchange with other environmental networks or purposes would be possible. A few systems are adapted and adopted across regions or in several countries (e.g. VETAB, ProPlant, NegFry, RIMpro, DSS Herbicide[5]). Nevertheless, the appropriate data format to enable a wider use of existing systems remains a challenge and is considered as a topic for further in-depth research and collaboration. Those findings are also supported by the results of the questionnaire and the telephone interviews conducted among European countries for the report "Analysis of research and extension needs for the development of IPM" within the SCAR Collaborative Working Group on integrated pest management.

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[5] http://www.dssherbicide.eu/

4 Questionnaire Part B: Collection of data on DSSs for crop protection regarding cross-border use and spatial data issues

4.1 Survey design

Part B of the questionnaire is linked to survey Part A Question 2 "Decision making tools for the implementation of IPM". The five sub-questions focus on cross-border use and spatial data issues of widely adopted DSS. As questionnaire we used the form of the ENDURE survey on Decision Support Systems (DSS) and Farm Management Systems[6] (FMS) in the year 2007 (see box below) as template and extended it with a section on cross-border use and spatial data.

> Within the European Network for the Durable Exploitation of Crop Protection Strategies (ENDURE) - a network of excellence (NoE) funded by the European Union under the Framework 6 program – an extensive survey on DSS was conducted among 27 EU countries and Switzerland. It was carried out jointly by the 11 institutions. The outcome was published as a report[7]. It provides an overview of the 'Progress and prospects for the implementation DSS's' in the domain of crop protection, which were under development and in use in the EU member states and Switzerland in the year 2008. Information was collected on 18 DSS for diseases in horticultural crops, 37 DSS for diseases in arable crops, 18 for pests and 9 for weeds.

We asked whether countries participated in the extensive ENDURE DSS/FMS 2007 survey and if this was the case, we wanted to gain more insight on cross-border use and spatial data issues of the individual DSS, especially concerning the following main areas of questions:

- Do experiences in cross-border use of the DSS exist?

- Does the DSS uses/produces directly or indirectly spatial data as input/output?

- Have opportunities/potentials for harmonisation of data input/output been identified?

We added these topics as a supplement to the ENDURE DSS/FMS 2007 questionnaire form which consists of a number of detailed questions within the main areas of questions[8]:

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[6] In the following report referred to as ENDURE DSS/FMS 2007 survey

[7] http://www.endure-network.eu/about_endure/all_the_news/dss_helping_farmers_make_smart_decisions

[8] For detailed information on the methodology of the ENDURE DSS/FMS 2007 survey, e.g. Motivation of questions included in that survey and the results please refer to the report.

- Which decisions are supported?
- Which approaches have been used to construct the DSS?
- How are recommendations communicated to end-users?
- How successful is the DSS?
- Have opportunities for integration been identified?
- How is distribution and updating being done?
- Have opportunities and potentials for unification been identified?
- In the context of the DSS, have new questions been raised to research?

We also encouraged the countries which already participated in the ENDURE DSS/FMS 2007 survey to update the information or add information for new systems that were introduced, if applicable. We especially encouraged those countries, not included in the ENDURE survey to get involved and share their information and experiences on DSS using the survey form.

The cover letter and full questionnaire are provided in the Annex. The questionnaire was sent by email in March 2012 to 38 national recipients, covering all European Member States and a number of Associated Countries.

4.2 Respondents

By February 2013, 7 national responses were received for questionnaire Part B. The responses provided new or updated information about 32 DSS: BE[9] (9), CZ (1), DE (10), FI (1), NL (10), PL (9), SE (2) with the number of individual DSS in brackets.

Most were comprehensive and clear but only few questionnaires were entirely answered. This is possibly due to the considerable amount of questions (78). Two out of 7 forms from PL were excluded as they were incomplete. It also has to be stated that the information provided by the respondents might not have been in their particular field of expertise.

4.3 Preliminary results

We analysed the answers on 40 systems on cross-border use and spatial data (tab. 3.1).

All original answers – including the ones on questions from the sections of ENDURE DSS/FMS 2007 - are stored in a relational database. For each question we stored the original answers and two additional fields for a formalization of the answers in "yes", "no", "unkown", "no answer given" and a field with related comments on the interpretation of the answers. We used simple SQL statements for further analysis.

In a second step the database should be extend with and compared to the results of the ENDURE DSS/FMS 2007 survey data. This information should be made available (also for editing and updating) via a collaborative web-based application in order to involve model owners/developers into the maintenance of information.

The contact details of owners/developers are listed in table 6.2 of the annex.

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[9] Among which 8 of the Wallonia region

Tab. 1 summarizes the DSS per country we received a contribution for. We assigned abbreviations to the DSS, that consist of the country code and (parts of) the model name. During the report, we refer to these names. Generally, answers are aggregated to a country's perspective.

Table 1: DSS identified in the survey

COUNTRY	NAME[1]	ABR[2]	CROP TYPE	CROP	PEST	TYPE OF DSS
BE	IRBAB*	be_irbab	non-cereals	sugar beet	pest; disease	not described
BE	AVERTISSEMENTS CADCO	be_wa_cadco	cereals	cereals	pest; disease	warning system
BE	CEHW*	be_wa_cehw	ornamentals	ornamentals	pest	not described
BE	CEPICOP*	be_wa_cepicop	fruit crops	grape	pest	not described
BE	CFW*	be_wa_cfw	fruit crops	small fruits	pest	not described
BE	CPL VEGEMAR*	be_wa_clp	horticultural	carrots; spinach; cabbage	pest	not described
BE	CEHW + GAWI*	be_wa_gawi	fruit crops	orchards	pest; disease	not described
BE	AVERTISSEMENTS MILDIOU	be_wa_mildiou	non-cereals	potato	pest	warning system
BE	AVERTISSEMENTS PUCERONS	be_wa_puceron	cereals	maize	pest	warning system
CZ	PROGNOSIS FOR POTATO LATE BLIGHT	cz_lateblight	cereals	wheat	disease	prognosis of potato late blight
DE	CERCBET1	de_cercbet1	non-cereals	sugar beet	disease	prognosis of cercospora
DE	CERCBET3	de_cercbet3	non-cereals	sugar beet	disease	disease control
DE	SEG_GETREIDE	de_seg	cereals	cereals	disease	disease control; 23 diseases
DE	SIMBLIGHT1	de_simblight1	non-cereals	potato	disease	disease prognosis
DE	SIMCERC3	de_simcerc3	cerealss	cereals	disease	disease control
DE	SIMLEP1	de_simlep1	non-cereals	potato	pest	pest prognosis
DE	SIMLEP3	de_simlep3	non-cereals	potato	pest	pest control
DE	SIMONTO	de_simonto	arable crops	cereals, oilseed rape	disease	disease prognosis
DE	SIMPHYT3	de_simphyt3	non-cereals	potato	disease	disease control
DE	SKLEROPRO	de_skleropro	arable crops	oilseed rape	disease	disease control
FI	WISUENNUSTE (WISUPROGNOSIS)	fi_wisuen	cereals	barley	disease	warning system (disease support system)
NL	CELERIAC	nl_celeriac	horticultural	celeriac	disease	leaf spot disease in celeriac
NL	CERDIS	nl_cerdis	cereals	cereals	disease	disease control in cereals
NL	DACOM- LEEK	nl_dacomleek	horticultural	leek	pest	trips control in leek
NL	DACOM- POTATO	nl_dacompotato	non-cereals	potato	disease	phytophthora infestans control in potatoes.

Tab. 1, continued

	NAME[1]	ABR[2]	CROP TYPE	CROP	PEST	TYPE OF DSS
NL	MYCOS	nl_mycos	horticultural	cabbage	disease	disease control in cabbage
NL	ONION	nl_onion	horticultural	onion	disease	leaf blight and downy mildew control in onion
NL	OPTIBOL	nl_optibol	ornamentals	flower bulb	disease	botrytis spp control in flower bulb crops
NL	PROCARO	nl_procaro	horticultural	carrots	disease	alternaria spp. control in carrot.
NL	PROPHY	nl_prophy	non-cereals	potatoes	disease	phytophthora infestans control in potatoes
NL	SCHURFTWEB.NL	nl_schurf	fruit crops	apple	pest; disease	scab and codling moth control in apple
PL	AVI SYSTEM + RIMPRO SYSTEM	pl_avisys	fruit crops	apple	disease	apple scab (venturia inaequalis) dss
PL	CLUBROOT	pl_clubroot	horticultural	cabbage	pest; disease	plasmodiophora brassicae (clubroot), economic threshold
PL	CUCUMBER DOWNY MILDEW	pl_cucumber	horticultural	cucumber	disease	pseudoperonospora cubensis (cucumber downy mildew)
PL	CUTWORM CONTROL IN SUGAR BEETS	pl_cutworm	non-cereals	sugar beet; potato	pest	decision support system (lep.; noctuinae, cutworms)
PL	BULL EYE ROT	pl_eyerot	fruit crops	apple	disease	pezicula sp. (bull eye rot or gloeosporium rot)
PL	ILBRAM	pl_ilbram	non-cerealss	potato	disease	web-based system providing the information on late blight threat to potato crops
PL	POWDERY MILDEW	pl_powmil	fruit crops	apple	pest	powdery mildew (podosphaera leucotricha)
SE	OGRÄSDATABASEN	se_ograes	arable crops	arable crops	weeds	weeds in arable crops
SE	VÄXTSKYDDSINFO	se_vaext	arable crops	arable crops	pest; disease	pest and diseases in arable crops

(1)   Name of the model. If no answer was given (*) the name refers to the owner of the model; (2) Abbreviation used in this report.

4.3.1 What kinds of DSS are identified in the survey?

Apart from 70 DSS already reported in the ENDURE DSS/FMS 2007 a number of new models were identified in most countries: BE (9), CZ (1[?]), DE (2), FI (1), NL (6[?]), PL (5), SE (2[?]).

In this SCAR survey all 23 systems are widely adopted and reported to be used for decision support in the following crops: arable crops incl. cereals (7) and non cereals (12); 7 systems in fruit crops, 8 in horticulture and two in ornamentals. 14 DSS are reported as control systems, 6 as prognosis systems the other DSS were not further specified. 22 DSS support decisions explicitly for diseases, 11 for pests, 6 DSS are reported for both, diseases and pests, one for weeds.

4.3.2 Do experiences in cross-border use of the DSS exist?

We asked, whether there is knowledge on DSS (developed in the own country) which is used in a different country. We received answers from all 7 counties to this question. BE reported that in one case (VETAB Project, 2000 - 2006) the DSS was developed in a collaboration of France, Flanders and Wallonia. BE and DE reported from experience in the Euroblight[10] project. DE reports for SYMPHYT1[11] & DE_SYMPHYT1, that the models were used on a regular basis in parts of Austria (State of Lower Austria). SE reports common work with DK on frit fly in the 90s. PL report experiences in two cases. CZ and FI reported no experience. None of the countries reported recent experience.

We then asked about knowledge on DSS developed in a different country and used in the own country, BE referred to the VETAB project. CZ reported the use of DSS for potato, beet and wheat diseases. FI reported the use of ProPlant models (DE, commercial). PL reported that the models RIMPRO & NEGFRY are used by farmers. SE reported the use of DACOM (NL, commercial), ProPlant (DE, commercial), vandregenskap (DK) and RIMPRO (NL, commercial).

Furthermore, we wanted to know, if modifications to the reported DSS are necessary in case of a (hypothetical) cross-border use.

BE reports only for be_wa_mildiou. For this model modifications are necessary[12]. CZ reports on the model cz_lateblight. Modifications are necessary according to the results of field trials carried and climatic conditions.

DE reports that no modification is necessary for de_skleropro, de_seg_getreide, de_simlep1, de_simlep3, de_simonto as long as the models are used in comparable climate zones. Some modification is necessary but possible for de_cercbet1, de_cercbet3, de_simblight1, de_simphyt3, de_simcerc3 as modification is limited to "paperwork" regarding the adaptations of variety lists.

PL reports that no modification is necessary for the DSS pl_eyerot, pl_powmil, pl_clubroot, pl_cucumber. Modifications are necessary for pl_ilbram and pl_cutworm. Both modifications are related to meteorological data. The answer was "unknown" for pl_avisys. FI reported

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[10] http://euroblight.net/

[11] Replaced by SIMBLIGHT1

[12] Reference was given to http://www.euroblight.net/euroblight.asp

"unknown", too. SE reports in a more general way that several systems had been tested and often modification is needed "in some way".

4.3.3 Hindrance in cross-border use of the DSS

We wanted to explore the bottlenecks for networking PMS at supra-national level. CZ reports for cz_lateblight the following hindrances: Existence of different resistant plant species and local climatic conditions and the necessity to evaluate/validate DSS models for the Czech conditions.

DE sees several kind of hindrances: 1) Availability of recent daily (hour basis) weather data (temperature precipitation, relative humidity; 2) the missing technical infrastructure for transferring weather data to model. 3) Legal aspects of weather data: Who pays for the data? 3) How is DSS provided to the farmer? 4) Scientific competition and a general preference for "the own" solutions (DSS).

PL sees no hindrances for pl_cucumber, pl_clubroot, pl_avisys, pl_eyerot, pl_powmil. For pl_cutworm the lack of meteorological data is reported. "unknown" is reported for pl_ilbram. SE mentions costs and (missing?) interest by the end user. BE (for be_wa_mildiou) and FI report "unknown".

4.3.4 Does the DSS uses/produces directly or indirectly spatial data as input/output?

The use of spatial data can lead to a more regionalized or spatially explicit decision support. At the same time the EU initiative INSPIRE[13] pushes the harmonization of spatial data (including e.g. meteorological data) on European level.

We asked whether spatial data are used as input for DSS. We received answers for DSS from BE, CZ, DE, FI, PL and SE to the question. Only CZ, DE and PL state, that spatial input data is used via the spatially explicit location of meteorological station. Although for other models, either no answer was given or "no" use was reported, we expect, that most of the DSS include the spatial location of meteorological station. DE uses precipitation data from the Federal Meteorological Agency (Deutscher Wetterdienst) in a 1km² resolution. The same spatial resolution is used for so called "virtual weather stations" (~200 000). They are a result of a daily interpolation of weather data (temperature, relative humidity). For each of the "virtual weather stations" models are run. Additionally DE reports regional parameters (e.g. crop rotation, pre-crops) used as spatial input to the models.

Only CZ, DE and PL state that spatial output data is produced. BE (be_wa_mildiou) produces maps with late blight epidemic extension during the growing season. CZ (cz_lateblight) produces maps representing the probability of occurrence of chosen pest (negative/positive prognosis). All of the DSS reported from DE produce risk maps based on the model results for the "virtual weather stations".

The final question referred to opportunities or potentials for harmonisation of data (input/output) that can be identified. BE, DE and PL identified the harmonisation of weather

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[13] http://inspire.jrc.ec.europa.eu/

data as "the" crucial point. Other answers were not given or answer was "unknown" or "none".

5 Conclusion

In the survey we collected information about the national institutional and organizational infrastructures concerned with the use and application of PMS (Part A) and detailed technical aspects of individual widely adopted DSS with an additional section on cross-border use and spatial data issues to gain more insight of the state of technology in these aspects (Part B). By summer 2012, 12 national responses (CZ, DE, EE, FI, FR, IE, NL, PL, PT, SE, TK, UK) were received for the survey part A and only 7 responses on 40 DSS (BE, CZ, DE, FI, NL, PL, SE) were received for the part B of the survey.

The supervision of pest monitoring systems and evaluation is mostly in responsibility of governmental institutions in cooperation and support by research institutions and national stakeholders such as boards of agriculture, national and regional advisory services. The development of PMS requires immense resources which is one of the reasons that DSS are only developed for the most damaging pests. Thus, benefits can be created by sharing systems based on a common ontology between countries or regions and for pests which currently occur rarely or below economic damage thresholds but are anticipated to become more damaging in the future. It is assumed that increased efforts to network PMS on a national but also the European level would create further benefits for the assessments of the efficacy and impact of control options on a long-term basis and across regions.

Part B delivered information about 23 DSS (out of 40) which had not already been included in the ENDURE DSS/FMS 2007 survey. The fewer answers compared to Part A indicate that the required detailed information seemed not to be at hand for the respondents. Nevertheless, the variation in the received answers gives an indication on experiences, opportunities, and limitations of cross-border use and spatial data issues. In future initiatives those first results of the ENDURE survey could be revisited and the best parts validated regarding their suitability for cross-border or supra national use.

In most of the corresponding countries experiences in cross border use exist, but these 1) relate to very few DSS; 2) experiences often originate from project collaborations 10-15 years ago or 3) current experiences are limited to commercial DSS. Reported bottlenecks regarding cross-border use are: 1) the availability of recent daily (hourly) weather data (temperature precipitation, relative humidity; 2) the missing technical infrastructure for transferring weather data into models; 3) legal aspects of weather data: Who pays for the data?; 4) How is DSS provided to the farmer?; 5) scientific competition, intellectual property issues for private institutions and a general preference for "the own" solutions (DSS). Nevertheless is remarkable, that for a number of DSS there are no technical limitations for cross-border use given that weather data is available.

It seems that spatial data plays a role in all DSS (although not explicitly answered) as weather stations with their geographic reference are often included. Few DSS need additional regional parameters (crop rotation, preceding crops). Some of the reported DSS produce spatially explicit risk maps (CZ, DE, PL).

In summary, cross-border use is recognized as useful, especially for minor crops or special pests. The availability of weather data in the "right" format is considered as the crucial point

in cross border approaches. Experiences exist but go back to a time, where data harmonization issues were not a topic on any official agenda. This is different today. The use of spatial data can lead to a more regionalized or spatially explicit decision support. EU initiatives such as INSPIRE[14] and SEIS[15] push the harmonization of (spatial) data (including e.g. meteorological data) on EU level. PMS activities such as in-field monitoring and surveillance are explicitly referenced as INSPIRE relevant spatial data (theme "environmental monitoring facilities"[16] in Annex III of directive 2007/2/EC (INSPIRE)). This means that Member States shall create the metadata, spatial data and services accordance within a given timetable. By the end of 2013 metadata shall be available.

This should be used for new experiences in cross-border use projects. Additionally, the situation of limited national funds and the anticipated spread of pests and diseases into different regions are further arguments to enhance multi-national collaboration to further develop and adapt PMS across regions.

5.1 CORE MESSAGES

- In future initiatives, the questions concerning the technical background information about DSS should be referred to national experts. The results of the ENDURE survey could be revisited and the identified best parts of DSS validated regarding their suitability for cross-border or supra national use.
- For the development and facilitation of PMS and DSS all concerned stakeholders (public and private) should work together as appropriate. Approaches should be developed to overcome limitations for potential collaborations as regards to the ownership, e.g. for weather data and IT architectures.
- The pivotal role of farm advisory services as regards to PMS for IPM implementation is to provide seasonal information about the development of major pests and diseases and to support the decision making process.
- In the future the scope of PMS and the evaluation of outcomes should be broadened from supporting short term seasonal decisions to include the long-term and non-intentional effects of pesticide use.
- It is assumed that increased efforts to network PMS on a national but also the European level would create further benefits for the assessments of the efficacy and impact of control options on a long-term basis and across regions.
- The exchange and adaptation of models is recognised as an opportunity for the efficient use of resources with shrinking national public budgets and human resources. Cooperation can be facilitated by enabling links between DSS by using a standard ontology and collating the data in harmonized formats that their exploitation and exchange with other environmental networks or purposes would be possible.
- Other efforts of European initiatives should be utilized such as the EU initiative INSPIRE to foster the harmonization of spatial data (including e.g. meteorological data) on European level.

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[14] http://inspire.jrc.ec.europa.eu/

[15] http://ec.europa.eu/environment/seis/

[16] INSPIRE (2007) - Environmental monitoring facilities; URL: http://inspire-forum.jrc.ec.europa.eu/pg/pages/view/1778/ [16.8.2013]

5.2 OUTLOOK to questions which could be addressed by national experts in future collaborations

- Which are the important items for DSS and their best parts for supra-national use?
- Which DSS cover the spatial distribution of pests and diseases, pest incidents and environmental impacts?
- Which DSS use spatial data input and would allow for a cross-border use?
- How could private organizations in public-private partnerships benefit from the supra-national use of their DSS?
- Which PMS activities are reported as INSPIRE relevant spatial data theme?

6 Annex

6.1 Survey cover letter and questionnaire

Survey
on pest monitoring systems across Europe
within the realm of integrated pest management

14 March 2012

The "Collaborative Working Group on integrated pest management for the reduction of pesticide risks and use" is conducting a survey on pest monitoring systems within the realm of integrated pest management (IPM). It builds on the survey of plant protection policies and associated research and extension relevant to IPM, which was conducted last year by the SCAR CWG. The Collaborative Working Group (CWG) was established in May 2011 under the Standing Committee on Agricultural Research (SCAR) to provide recommendations on research needs to the EC's DG Research and Innovation and to Member and Associated States. The 17 countries currently in the CWG share the goal of improving plant protection strategies through information sharing and joint initiatives.

Goal of this survey

The goal of this Europe-wide survey is to map out the current situation on pest monitoring systems (PMS) for integrated pest management. PMS integrate a wide range of domains, from forecast and monitoring of pests and diseases, warning and alert systems to scouting thresholds and advisory services on integrated pest management. It also covers a wide range of actors including farmers, advisors, scouts, people from government, industry, researcher etc. In this respect *pest monitoring systems* are not limited to computer-based systems but comprise initiatives, networks, activities, tools etc. that assist farmers in taking the right decision in integrated pest control.

The three major components of PMS and their interlink are in the focus of this survey:

In-field monitoring/surveillance/scouting: Up-to-date and periodic in-field monitoring/ surveillance/scouting of weeds, pests and diseases;

Decision support systems: Alert systems, simulation and forecasting systems which help famers to identify monitor and control weeds, pests and diseases;

Pest warning services by extension services/advisors: Specific advice from independent extension services/advisors. The advice is generally based on individual professional working experience and the interpretation of up-to-date DSS outcomes and monitoring/surveillance/ scouting results.

The outcome of the survey will serve to identify what research and development is needed to support PMS, assess the added value and opportunity of jointly addressing needs and finally, make recommendations on cross-national initiatives.

Expectations

By inviting Member States and Associated States to contribute to this survey, the CWG expects to draw a picture at European level of the various national PMS and the variety of approaches, technologies, outcomes and experiences. Targeted collaboration and networking of PMS at supra-national level can certainly provide benefit and stimulation for EU and national oriented research.

How to respond

Please forward each part (A and B) of this survey to the person(s) in your country that can best cover the following areas of plant protection:
- institutional organisation of pest monitoring systems and surveillance activities
- development and use of decision support systems

- generating advice based on DSS and surveillance results.

In this part A, please provide brief answers (about 10 lines per answer) in English to the 12 questions below. In addition, you are invited to include links or attachments to relevant documents.

Part B, please forward to any person who do you think can most appropriately answer the detailed questions.
    If possible, please compile all answers into a single national response and send back by

May 15 2012, to:

marco.barzman@grignon.inra.fr & silke.dachbrodt-saaydeh@jki.bund.de

If you need clarification on the questionnaire, please contact:

silke.dachbrodt-saaydeh@jki.bund.de

Questionnaire Part A

Question 1.   Actions of in-field monitoring/surveillance/scouting

Name, organisation and position of respondent to Question 2:

_____

email:_____

a. Do you have national crop protection policies in force or planned which addresses the in-field monitoring/surveillance/scouting for the implementation of integrated pest management?

If yes, please briefly describe these policies.

b. For any of the following do you have existing or planned activities of in-field monitoring/surveillance/scouting?

If yes, please briefly describe these activities.

Example catchwords to elaborate on: target - regional/national - private/public - crop/pest specific- role of state/research/farmers- manpower - funding – interlink to other PMS – pooling of outcome – web-based central contact point

pest/disease/weeds

pesticide resistance

pesticide use

unintended effects of pesticide use

biodiversity

GMO related

invasive alien species

c. Do official institutions exist or are planned which oversee and/or steer/control/evaluate the use, outcome and quality of in-field monitoring/surveillance/ scouting? Are other institutions involved?

If yes, please briefly describe

> *Example catchwords to elaborate on: target - regional/national - private/public - crop/pest specific- role of state/research/farmers- manpower - funding – interlink to other PMS – pooling of outcome – web-based central contact point*

d. Do experiences exist to link activities of the different in-field monitoring/surveillance/ scouting mentioned in question b) as well as to take advantage from other environmental monitoring networks?

If yes, please briefly describe

> *Example catchwords to elaborate on: interlinked activities - goal - regional/national - private/public – role of state/research/farmers*

Question 2.   Decision making tools for the implementation of IPM

Name, organisation and position of respondent to Question 1:

_____

email:_____

a. Did your country participate in the ENDURE survey on Decision Support Systems (DSS) and Farm Management Systems (FMS) in the year 2007 [17]?

___ Yes	If yes, but you feel that information needs to be updated, new systems have been introduced, or DSS have not been considered please use the form in the Annex 1
	If no, but you are interested in sharing your information and experience by contributing to the follow up of the ENDURE DSS/FMS survey please use the form in the Annex 1;
___ No	**We encourage all countries included in the ENDURE DSS/FMS 2007 survey to review their information for the new topic _Cross-border use and spatial data_**
	We especially encourage those countries, not included in the ENDURE DSS/FMS 2007 survey to get involved and share their information and experiences.

b. Do you have national crop protection policies in force which addresses the use of DSS for the implementation of integrated pest management? Or is one planned?

If yes, please briefly describe these policies.

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[17] For information on this survey (participating countries, DSS/FMS included, results) please follow the link: http://www.endure-network.eu/about_endure/all_the_news/dss_helping_farmers_make_smart_decisions

c. Do official institutions exist or are planned which oversee and/or steer/control/evaluate the use, outcome and quality of DSS? Are other institutions involved?

If yes, please briefly describe

Example catchwords to elaborate on: target - regional/national - private/public - crop/pest specific-role of state/research/farmers- manpower - funding – interlink to other PMS – pooling of outcome – web-based central contact point

d. Do you have official institutions for the development and maintenance of DSS? Are other institutions involved?

If yes, please briefly describe

Example catchwords to elaborate on: regional/national - private/public - crop/pest specific- role of state/research/farmers- sustainability - manpower - funding – interlink to other PMS

e. Do you see benefits for your country in cross-border use of DSS? What do you consider as main chances and/or bottlenecks?

If yes, please briefly describe

Example catchwords to elaborate on: crop/pest - technical/institutional – critical input data/ data availability - ownership-accessibility-costs

Question 3.   Pest warning services by extension services/advisors

Name, organisation and position of respondent to Question 3:

_____

email:_____

a. Do you have national crop protection policies in force or planned which address the role of extension/advisory services for the implementation of integrated pest management?

If yes, please briefly describe these policies.

b. Which types of extension/advisory services exist or are planned?

If yes, please briefly describe

Example catchwords to elaborate on: national/regional/crop specific - proportion of official/private/dependent/independent– outputs – role of state/research/farmers– manpower indicator e.g. per farm/arable land – funding – steering – controlling – outputs - bottlenecks

Do networks of PMS exist where advisory/extension services, outcomes of DSS and monitoring? Or are such activities planned?

If yes, please briefly describe

Example catchwords to elaborate on: national/regional/crop specific – size of networks - official/private/dependent/independent– outputs – role of state/research/farmers – funding – steering – controlling – outputs- bottlenecks

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Questionnaire Part B

Form for collection of data on DSSs for crop protection in EU-countries and Switzerland

ENDURE

A survey on Decision Support Systems (DSSs)

for crop protection in EU-countries

Identification of a DSS and the data collector

Characteristics for identification of a DSS (Separate forms must be used for separate DSSs. Separate forms can also be used for different modules of a DSS)	(Write)
Name (If no official name exist of the DSS, please define an acronym for this survey)	
Country of origin	
Status on ownership (Institution names, address, contact persons)	
Key persons involved (Contact persons and key roles)	
Identification of data collector (Title, full name, employer and e-mail address of person conducting the collection of data in this form)	

Documentation

Sources of documentation for this survey (Research papers, conference papers, popular articles, personal communication, etc.)	Ref. no.

Existence of basic attributes required, to constitute a DSS that is relevant for this survey

Attributes (For each question at least one 'yes' must be stated. Otherwise the DSS is not relevant for the survey)	Yes (Write)	Comments (Write)	Ref. no.
1. Evaluation of economic thresholds and/or recommendations of options for treatment	____ Yes, use of economic thresholds ____ Yes, recommendation of options for treatment		
2. Integration of various sources of information (Some 'added value' as compared to label- and standard recommendation must be demonstrated, please comment)	____ Yes		
3. Use of decision algorithms and/or calculation models. (Some 'added value' as compared to label- and standard recommendation must be demonstrated, please comment)	____ Yes, decision algorithms ____ Yes, calculation models		
4. Is operational from a computer	____ Yes		

Features

Which decisions are supported?	Yes/No	Comments (Write)	Ref. no.
1. Which crop/pest systems? (Combinations of crops and pests or groups of pests, e.g. '30 species of seeded weeds')			
2. Short term (tactical) decisions?	___ Yes		

(Decisions for a growing crop)	___ No ___ Don't know		
3. Long term (strategic) decisions? (Decisions taking into account aspects of crop rotation)	___ Yes ___ No ___ Don't know		
4. Decisions made by farmers? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		
5. Decision made by consultants? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		
6. Identification of pests? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		
7. Monitoring of pests? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		
8. Evaluation of economic thresholds? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		
9. Suggestion of treatments options? (Explain type of treatment: chemical, biological, mechanical, thermic, integration of different techniques, etc. Explain also differentiation on treatment, e.g. intensity of machinery, reduction of pesticide dose rates, mixes, adjuvants, etc.)	___ Yes ___ No ___ Don't know		
10. Instructions on treatment implementation? (E.g. instructions on adjustment of machinery, mixing of spray volume, spraying technique, etc.)	___ Yes ___ No ___ Don't know		
11. Instructions relating to weather conditions? (E.g. influence of weather on pest sampling, pest development or performance of pesticides)	___ Yes ___ No ___ Don't know		

12. Instructions on follow-up? (Evaluation of effect of treatments, strategy and timing of additional treatments, next move, etc.)	___ Yes ___ No ___ Don't know		
13. Use of cost/benefit analyses? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		
14. Are there any considerations of implications for pesticide resistance? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		
15. Is any information/support provided on the potential environmental impact of different control options? (If 'yes' please explain)	___ Yes ___ No ___ Don't know		
16. In a local perception: are there some main 'added value' as compared to other DSSs dealing with the same pests? (If 'yes' please explain)	___ Yes ___ No ___ Don't know		

Modelling approaches

Which approaches have been used to construct the DSS?	Yes/no	Comments (Write)	Ref. no.
1. Use of decision algorithms? (If 'yes' please explain main principles)	___ Yes ___ No ___ Don't know		
2. Use of calculation models? (If 'yes' please explain type of calculation or write mathematical expressions)	___ Yes ___ No ___ Don't know		
3. Optimisation for certain criteria? (If 'yes', please stated criteria used for optimisation)	___ Yes ___ No ___ Don't know		
4. Methods for estimating parameters for calculation models? (Describe methods. Use of central estimates, biassed estimates, estimates guessed by experts, inter- and extrapolations, copy of estimates from different 'conditions', etc.)			
5. Are there critical requirements for development and maintenance? (Supply of data, theoretical assumptions, etc.)	___ Yes ___ No ___ Don't know		
6. In a local perception: are there some main originality as compared to DSSs dealing with the same pests? (If 'yes' please explain)	___ Yes ___ No ___ Don't know		

Communication of results

How are recommendations communicated to end-users?	Yes/no	Comments (Write)	Ref. no.
1. Give a short description of the process of using the DSS by the end user (What kind of data to input, what kind of output, which steps of running the DSS, how			

long time to get recommendations)			
2. Is original research data presented to the end-user? (If 'yes', please explain how)	___ Yes ___ No ___ Don't know		37
3. Can recommendations from the DSS be traced back to original research data, other kinds of data and/or original expert statements? (If 'yes', please explain how)	___ Yes ___ No ___ Don't know		
4. Are algorithms and calculations used in the DSS, transparent to end-users (If 'yes', please explain how)	___ Yes ___ No ___ Don't know		

Impact

How successful is the DSS?	Yes/no	Comments (Write)	Ref. no.
1. What is the extent of model validation? (Number of years, crops, trials, etc.)			
2. Have potentials been identified? (If 'yes', please quantify. Eg. potentials for reducing use of pesticides, potentials for larger economic profits, potential for more environmentally friendly control of pests etc.)	___ Yes ___ No ___ Don't know		
3. Have increased risks to crop safety and/or farm economy been identified? (If 'yes', please explain the nature of the risk, and the magnitude of the risk)	___ Yes ___ No ___ Don't know		
4. How many end-users? (Preferably in some groups of main target end-uses and perspectives)			
5. How actively are end-users using the DSS? (E.g. surveys or end-user performance, statistics on number of consults, etc.)			
6. Has end-users been responding? (Questionnaires, reports from help-desk, correspondence wit 'web-master', etc.)	___ Yes ___ No ___ Don't know		
7. How efficient is the transfer from DSS to field? (End user confidence with recommendations from system, call for second opinions, use of 'practical' adjustments, etc)			
8. Have factors promoting take-up been identified? (E.g. training, campaigns, advertising, discounts, etc.)	___ Yes ___ No ___ Don't know		
9. Have factors constraining take-up been identified?	___ Yes ___ No		

(Lack of motivation, lack of economic incentives, competition, lack of interest in computers, etc.)	___ Don't know		39
10. Have specific interests in different groups of stake-holders been identified regarding take-up? (Competition/conflicts with other suppliers of decision support)	___ Yes ___ No ___ Don't know		
11. In a local perspective: what are the main drawbacks/limitations of the DSS in its current state of development?			

Opportunities and potentials for integration

Have opportunities for integration been identified?	Yes/no	Comments (Write)	Ref. no.
1. With farm management systems (FMS)? (If 'yes', please comment)	___ Yes ___ No ___ Don't know		
2. With site-specific pest management systems? (If 'yes', please comment)	___ Yes ___ No ___ Don't know		
3. With suppliers of 'meta-data'? (E.g. suppliers of weather data, characteristics on crops, on crop cultivars, pesticides, machinery, etc.)	___ Yes ___ No ___ Don't know		
4. With other 'systems'? (If 'yes', please explain)	___ Yes ___ No ___ Don't know		

Distribution and updating

How is distribution and updating being done?	Yes/no	Comments (Write)	Ref. no.
1. Means of distribution? (E.g. CDs, download of files from internet, files sent by emails, online access via Internet, etc.)			
2. Frequency of updating? (E.g. annually, monthly, weekly, daily, etc.)			
3. Cost of the system to end-users? (Major groups of end-users, annual basis)			

Unification

Have opportunities and potentials for unification been identified?	Yes/no	Comments (Write)	Ref. no.
1. Opportunities? (If 'yes' please comment. E.g. between pest, between crops, between geographical regions)	___ Yes ___ No ___ Don't know		
2. Potentials? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		
3. Shortcomings? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		
4. Critical assumptions? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		
5. Critical requirements? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		
6. Restrictions relating to ownership? (On what terms can the DSS or parts of it, be used by other institutions/countries)	___ Yes ___ No ___ Don't know		
7. Restrictions relating to access to the system? (Can the DSS, or parts of it, technically be used in other institutions/countries)	___ Yes ___ No ___ Don't know		
8. Costs of the system, or parts of it when used for further development in other institutions/countries? (Principles of cost calculation or price list)			

Feedback to research

In the context of the DSS, have new questions been raised to research?	Yes/no	Comments (Write)	Ref. no.

1. To develop new models or sub-models? (If 'yes' please comment)	___ Yes ___ No ___ Don't know		
2. To parameterise existing models? (If 'yes' please comment)	___ Yes ___ No ___ Don't know		
3. To validate DSSs? (If 'yes' please comment)	___ Yes ___ No ___ Don't know		
4. To other issues? (If 'yes' please comment)	___ Yes ___ No ___ Don't know		

ANNEX 1

Cross-border use and spatial data issues[18]

Does experiences in cross-border use of the DSS exist?	Yes/no	Comments (Write)	Ref. no.
1.Experiences a) Do you know about a DSS (developed in your country) which is used in a different country? (If 'yes' please describe/ If 'no'/'don't know, please describe feasibility)	___ Yes ___ No ___ Don't know		
b) Do you know about a DSS (developed in a different country) which is used in your country? (If 'yes' please describe/ If 'no'/'don't know, please describe feasibility)	___ Yes ___ No ___ Don't know		
2. Modifications to the DSS necessary? (Please comment which modifications would be/were necessary?)	___ Yes ___ No ___ Don't know		
3. Hindrance? (If 'yes' please comment hindrances)	___ Yes ___ No ___ Don't know		
4. Contributes to a supranational network? (If 'yes' please comment)	___ Yes ___ No ___ Don't know		

Does the DSS uses/produces directly or indirectly spatial data as input/output?	Yes/no	Comments (Write)	Ref. no.
1. Uses spatial input? (If 'yes' please describe type, format, standards, metadata)	___ Yes ___ No ___ Don't know		
2. Produces spatial output?	___ Yes		

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[18] New Topic related to the SCAR TWG Survey on PMS across Europe within the realm of integrated pest management

(If 'yes' please describe type, format, standards, availability, metadata)	___ No ___ Don't know		
3. To produce digital maps? (If 'yes' please describe type, format, standards)	___ Yes ___ No ___ Don't know		

Have opportunities/potentials for harmonisation of data input/output been identified? If yes, please name specific requirements	Yes/no	Comments (Write)	Ref. no.
1. Opportunities? (If 'yes' please comment. E.g. Spatial/temporal resolution of weather data)	___ Yes ___ No ___ Don't know		
2. Potentials? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		
3. Shortcomings? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		
4. Critical assumptions? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		
5. Critical requirements? (If 'yes' please comment. E.g. from previous experiences)	___ Yes ___ No ___ Don't know		

6.2 Contact/Owner of DSS reported in Part B

COUNTRY	GEN_JKI_NAME	CONTACT/OWNER
BE	be_wa_clp	CPL Vegemar
BE	be_wa_cepicop	CePiCOP (Centre Pilote des Céréales et Oléoprotéagineux de la RW)
BE	be_irbab	IRBAB (*Belgian* Institute on Sugar beet Research)
BE	be_wa_cadco	CADCO Centre Agricole pour le Développement des Céréales et des Oléo-protéagineux
BE	be_wa_puceron	Centre Pilote Maïs (CIPF, CARAH, CPL Végémar, OPA prov de Namur)
BE	be_wa_cfw	CFW
BE	be_wa_mildiou	Centre Pour l'Agronomie et l'Agroindustrie de la Province de Hainaut a.s.b. (CARAH asbl)
BE	be_wa_cehw	CEHW
BE	be_wa_gawi	CEHW + GAWI
CZ	cz_lateblight	State Phytosanitary Administration (SPA)
DE	For all reported DSS	Central Institution for Decision Support Systems in Crop Protection (ZEPP); Rüdesheimer Strasse 60-68; 55545 Bad Kreuznach; http://www.zepp.info
FI	fi_wisuen	ProAgria Agricultural Data Processing Centre Ltd; Urheilutie 6, 01301 Vantaa, Finland; contact: jani.kivipelto@mloy.fi
NL	nl_mycos	Agrovision (1); http://www.agrovision.nl/agrarier/teelt/slim-spuiten/
NL	nl_celeriac	Agrovision (1); http://www.agrovision.nl/agrarier/teelt/slim-spuiten/
NL	nl_cerdis	Agrovision (1); http://www.agrovision.nl/agrarier/teelt/slim-spuiten/
NL	nl_schurf	DLV Plant B.V. Lingewal 1, 6668 LA Randwijk http://www.dlvplant.nl/nl/content/schurftweb.html
NL	nl_dacomleek	Dacom B.V. Postbus 2243, 7801 CE Emmen, The Netherlands http://www.dacom.nl/index.php/en/agri-yield-management-en
NL	nl_dacompotato	Dacom B.V. Postbus 2243, 7801 CE Emmen, The Netherlands http://www.dacom.nl/index.php/en/agri-yield-management-en
NL	nl_onion	Agrovision, http://www.agrovision.nl/agrarier/teelt/slim-spuiten/
NL	nl_optibol	Agrovision (1); http://www.agrovision.nl/agrarier/teelt/slim-spuiten/
NL	nl_prophy	Agrovision (1); http://www.agrovision.nl/agrarier/teelt/slim-spuiten/
NL	nl_procaro	Agrovision (1); http://www.agrovision.nl/agrarier/teelt/slim-spuiten/
PL	pl_cutworm	Institute of Plant Protection; National Research Institute, Pozna, Poland Magdalena Jakubowska, M.Jakubowska@iorpib.poznan.pl
PL	pl_clubroot	Research Institute of Horticulture; Konstytucji 3 Maja 1/3; 96-100 Skierniewice, Poland- JÓZEF ROBAK
PL	pl_ilbram	Institute of Plant Protection, Ul. Wadysawa Wgorka 60-318 Pozna
PL	pl_cucumber	Research Institute of Horticulture; Konstytucji 3 Maja 1/3; 96-100 Skierniewice, Poland- JÓZEF ROBAK
PL	pl_powmil	Research Institute of Horticulture; Konstytucji 3 Maja 1/3; 96-100 Skierniewice, Poland- Sylwester Masny
PL	pl_eyerot	Research Institute of Horticulture; Konstytucji 3 Maja 1/3; 96-100 Skierniewice, Poland- HANNA BRYK
PL	pl_avisys	Research Institute of Horticulture; Konstytucji 3 Maja 1/3 96-100 Skierniewice, Poland- Sylwester Masny
SE	se_ograes	Swedish Board of Agriculture; Karin Jahr Växtskyddscentralen, Dragarbrunnsgatan 35, 753 20 UPPSALA

SE	se_vaext	Swedish Board of Agriculture; Alf Djurberg; Växtskyddscentralen, Östgötagatan 3, 581 86 Linköping

(1) Agrovision, Postbus 755 7400 AT Deventer, The Netherlands

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