ENDURE

European Network for Durable Exploitation of crop protection strategies

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Survey of "ongoing research and facilities"

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PU Public	**PU**
PP Restricted to other programme participants (including the Commission Services)	
RE Restricted to a group specified by the consortium (including the Commission Services)	
CO Confidential, only for members of the consortium (including the Commission Services)	

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Summary

A survey is made of all research projects ongoing and related to integrated control strategies. Included in the survey are the facilities of the different research institutes. A recommendation is made to co-ordinate the different research programs to come to better utilization of research.
It was found that 23 institutes work on apple scab (*Venturia inaequalis*), of which 8 participate in Endure, 23 institutes work on codling moth (*Cydia pomonella*), of which 10 participate in Endure and 9 institutes work on brown spot of pear (*Stemphylium vesicarium*), of which 2 participate in Endure. It was noted that few projects showed up from new EU-countries.
Several projects have good contacts with extension services.
A substantial number of projects are focusing on background information for further development of integrated control strategies. While also many projects are evaluating integrated control strategies in practice.
With respect to the different elements of integrated control strategies it is noted that development of warning systems is done by many projects.
A wide range of both expertise and facilities is available in the different institutes varying from advanced DNA-analyses equipment till near practice experimental field facilities.

1 Introduction

Pomefruit (apple and pear) are major European crops and integrated pomefruit production has one of the oldest histories in agriculture. Although integrated pomefruit production is common in the majority of European countries, not the total area of pomefruit production has implemented IPM. And, scab (*Venturia* spp.), brown spot (*Stemphylium vesicarium*) and codling moth (*Cydia pomonella*) are still responsible for large scale chemical crop protection and residues on fruits, which damage the health image of fruits. Though these diseases and pests are present in nearly all European countries, there are marked differences in impact between northern and southern regions in Europe. The majority of pesticides are targeted to control diseases in the northern part of Europe. While in southern Europe, control of insects is consuming considerable amounts of insecticides.

It is the aim of the Case Study Pomefruit to demonstrate the effectiveness, feasibility and acceptability of preventive or protective integrated control strategies, specific for different agro-ecological systems and possibly specific for different parts of Europe. A survey is made of all research projects ongoing and related to integrated control strategies as a first step to achieve this aim.

Tasks were split among Endure participants to collect all the information for the three earlier mentioned diseases and pest. B. Heijne assembled the information which is presented in this deliverable.

2 Materials and methods

2.1 Data collection

During the meeting of members of the Endure Case Study Pomefruit at Avignon, 26-27 April 2007, tasks were split among Endure participants to collect all the information for the three earlier mentioned diseases and pest. K. Paaske (Aarhus University) was leading the collection of this information on apple scab and specifically assisted by A. Patocchi (Agroscope Wädenswill) and L. Parisi (INRA). B. Heijne (PPO-fruit Wageningen UR) was leading the collection of this information on brown spot of pear and specifically assisted by J. Avilla (University Lerida UdL). J. Avilla (University Lerida UdL) was leading the collection of this information on codling moth and specifically assisted by J. Samietz (Agroscope Wädenswill) and B. Sauphanor (INRA). B. Heijne assembled all the information which is presented in this deliverable.

2.1.1 Self expanding network

The collecting information was set-up as a self expanding network. Participants of the case study contacted known colleagues from other institutes. An important question asked to these colleagues from other institutes was “Do you know other scientists or institutes working on similar or related projects?” Subsequently, the mentioned scientists or institutes were contacted if not yet listed. These new contacted persons were also asked the same question. And so on.

2.1.2 Procedure

Participants of the case study firstly contacted colleagues by e-mail. In this first e-mail contact information was given about the network of excellence project Endure in general. Additionally, information was presented about the role of the Case Studies within Endure and the specific goals of the Pomefruit Case Study (Appendix 4).

Contacted scientists were asked to fill-out an attached form. Information was asked about name of their institute, on-going research projects and their project leaders and contact persons, the facilities of their institutes and their expertise in relation to the integrated control strategies. Of course, contact details were asked. And, important for the spread of knowledge, if they have regular contacts with extension organizations.

If necessary, as a follow-up of first e-mail contacts, some scientists were additionally contacted by phone. Either to speed-up the collection of information or to ask more precise information.

3 Results

The results of the total inventory are completely given in the Appendices 1, 2 and 3 for apple scab, codling moth and brown spot of pear respectively. In the following paragraphs an analysis of the collected information is presented. With respect to the projects, analyses were made on the subject of projects and the projects are characterized into different categories of integrated control strategies. Also the expertise and the research facilities of the institutes actively performing the projects are analyzed.

3.1 Projects versus institutes

It was not always clear how projects were defined by collection of information from different institutes. Some institutes have fixed projects with clearly defined what belongs to a project and what not and fixed ending dates. While other institutes have a wide subject of research, which is seen as a project. In the table below a summary is given of the number of institutes and projects as a result of the inventory.

Table 3.1: The number of institutes developing or testing integrated control strategies and the number participating in Endure.

	apple scab	**brown spot**	**codling moth**
institutes within Endure	8	2	10
institutes outside Endure	15	7	13
total number of institutes	23	9	23
contacts with extension services	17	5	7

Coincidently the number of institutes working on integrated control strategies for apple scab and codling moth is both 23. In contrast 9 institutes work on brown spot of pear. The latter is remarkable for a disease that so recently appeared. May be this reflects the damaged caused by the diseased and the difficulty to control it with standard fungicides. A substantial number of institutes working on integrated control strategies are participating in Endure.

It is noted that especially projects on integrated control of apple scab and brown spot of pear have many contacts with extension services.

3.2 Subject of projects

During the inventory it became clear that the subject of the projects sometimes differed strongly, although all were related to integrated control strategies. Therefore, all projects were put into five classes to get a better picture of these details.
The classes of projects were defined as:

1. Investigation of background, more fundamental information necessary to develop new integrated control strategies.
2. Development of resistance mechanisms and resistant cultivars, inclusive breeding new resistant cultivars.
3. Development of practical integrated control strategies.
4. Testing and validation integrated control strategies in practice.
5. Organic control strategies.

Table 3.2: The number of projects falling into the different classes of projects as defined before.

class	apple scab	brown spot	codling moth
1. background, fundamental information	14	8	15
2. resistance mechanisms and cultivars	6	1	0
3. development of practical integrated strategies	9	7	16
4. testing and validation strategies in practice	10	5	8
5. organic control strategies	5	0	1

It was found that a substantial number of projects were focussing on background and more fundamental knowledge for the development of future integrated control strategies. This was the case not only for a relative new disease brown spot on pear, where this was expected. But also for the well studied disease apple scab and the pest codling moth.
One of the most environmental friendly integrated control strategies is the use of resistant cultivars. Only for diseases and mainly for apple scab this strategy is worked on in projects in different European countries.
It is remarkable that relatively low number of projects is developing strategies for organic culture. This falls not within the core objectives of Endure, but it was mentioned in the inventory forms several times. And is therefore presented here. Though it might not provide a complete picture, because it was not specifically asked for.

3.3 Category of projects

Artificial categories of projects were defined to analyse the projects for the specific elements of integrated control strategies. Specific elements of integrated control strategies are:

1. warning systems or decision support systems
2. pesticide side-effects
3. sanitation practices
4. natural or organic acceptable compounds
5. natural enemies (predators and parasitoids) and biocontrol organisms (BCA)
6. resistant cultivars
7. Others such as life cycle, phenology, olfactory strategies, etc.

Table 3.3: The number of projects involved in different elements of integrated control strategies.

elements of integrated control strategies	apple scab	brown spot	codling moth
1. warning systems or decision support systems	12	6	14
2. pesticide side-effects	6	2	10
3. sanitation practices	6	4	0
4. natural or organic acceptable compounds	8	0	6
5. natural enemies (predators and parasitoids) and biocontrol organisms (BCA)	3	5	8
6. resistant cultivars	8	2	1
7. others, such as life cycle, phenology, odour (olfactory) strategies, etc	8	7	12

It is noted that a lot of projects are involved literal in integration, by developing warning systems or decision support systems. This shows a very practical approach to reduce environmental impact of pesticides while at the same time adequately controlling the diseases or pests.
Relatively low number of projects is involved in development of biocontrol agents (BCA's) for diseases. This might be linked to the EU regulation for the release of BCA's. On the other hand, a relative high number of projects deal with natural enemies of codling moth.
Especially for codling moth, a lot of projects deal with olfactory aspects (kairomones, plant volatiles, pheromones, etc.). Some of these are already successfully implemented such as pheromone disruption techniques.

3.4 Expertise

The different research groups also have partly different expertise and accordingly different research facilities. The latter is dealt with in the next paragraph. Expertise is linked not only to on-going projects but also to already finished projects. Especially for integrated control strategies involvement of different expertises can be a key factor for successful strategies, and hence in successful projects. In the following table the number of projects is given for the different expertises of the institutes involved in development or testing of different integrated control strategies.

Table 3.4: Number of projects with different expertises for the development or testing of integrated control strategies.

expertise	apple scab	brown spot	codling moth
1. warning systems or decision support systems	12	5	12
2. integrated control with pesticide activity	7	4	15
3. side effects of pesticides	5	1	6
4. sanitation practices	5	4	0
5. organic control	4	0	2
6. natural enemies (predators and parasitoids) and biocontrol organisms (BCA)	4	4	10
7. field research	11	6	11
8. host pathogen / insect interaction	4	2	4
9. population dynamics / epidemiology	6	5	8

10. resistance mechanisms and breeding	9	0	0

A wide range of expertises was found within projects from institutes all over Europe for development and implementation of integrated control strategies. Especially expertises useful for development of practical strategies were found within many institutes. These were: warning system and modelling expertise, knowledge of pesticides properties, influencing natural enemies, field research and population dynamics in insects or epidemiology in diseases. Field research, although often costly, is often implemented in development of integrated control strategies.

3.5 Research facilities

Similar to expertises, research groups also have partly different research facilities. The different research facilities used in different projects are summarized in table 3.4.

Table 3.5: Number of projects with different research facilities for the development or testing of integrated control strategies.

expertise	**apple scab**	**brown spot**	**codling moth**
1. on-farm research	9	3	4
2. experimental fields	16	5	11
3. standard entomological of phytopathological laboratory	14	7	13
4. climate room / cabinet	12	6	12
5. green house (either or not climate controlled)	12	5	9
6. physiological laboratory	11	1	3
7. molecular (DNA) / microbial laboratory	14	4	3
8. fungi collection / insect rearing facilities	2	2	3
9. meteorological station	5	1	3
10. commercial sprayers	6	1	1

Again the importance of experimental fields is demonstrated in this analysis. Moreover, several projects and institutes have regular contacts and good relationships with farmers to use their commercial orchards for on-farm research. Oppositely, also advanced laboratories are used, especially to collect fundamental knowledge for which form the basis for integrated control strategies. It is remarkable, the limited number of meteorological stations available, although many projects deal with development of warning systems or decision support systems. Probably, meteorological data come available for research through other partners.

4 Discussion and conclusion

4.1 Discussion

A self expanding network was used to collect the information about ongoing research and their facilities. It is quite surprising though, that only few institutes and projects appeared in the information from new EU-countries. Especially the absence of Poland, Bulgaria, Slovenia and the Baltic states is remarkably, while it is known that these countries have substantial production of pomefruit. This might suggest that scientists from the old EU-countries have little contacts with scientists from the new EU-countries.

Cooperation with extension services was also informed and it appeared that many institutes especially those dealing with disease control strategies have many contacts. Moreover, it was noted that several extension services do practical research themselves. A good cooperation between research institutes and extension services is most valuable and provides an excellent base for quick implementation of validated control strategies.

There is always a balance between open exchange of new information and ideas on one side and being the first to publish new results on the other side. This seems more applicable for more fundamental expertise than for integrated control strategies. There is a good system of information exchange in several European symposia and workshops, e.g. ISHS, IOBC and AAB.

4.2 Conclusion

It is concluded that:

1. There is a sound basis for further development of integrated control strategies in Europe.
2. And good contacts with extension services will help to implement already existing and future strategies.
3. More contacts with new EU-countries are needed to further implement integrated control strategies also in this part of Europe.

4.3 Recommendations

It is recommended that:

1. Information about integrated control strategies are more carefully distributed to new EU-countries.
   1.1. The previous might be achieved by specifically inviting scientists from these countries to participate in European symposia and workshops.
   1.2. By organising these workshops in those new EU-countries.
   1.3. By inviting institutes from those new EU-countries to participate in future EU-projects.
2. A similar inventory is also made for pear psylla and storage diseases of pomefruit as the other major pesticide consuming pest and disease, with good possibilities to exchange information and implement integrated control strategies.
3. Investigate why so much projects deal with resistant cultivars, while few resistant cultivars are planted in practice.

4. Substantial efforts are paid to development of integrated control strategies of brown spot of pear because of the rapid expansion of this devastating disease over Europe.
5. Organise a European brown spot symposium.
6. Extension services are more and more implemented in future European projects to help implement the results of the projects into practice.
7. Allow demonstration projects of on-farm research for funding though the EU with the purpose to quickly implement new integrated control strategies.

5 Acknowledgement

The coordinator of this subtask Case Study Pomefruit, Bart Heijne, is indebted to the warm and constructive support from the Endure participants of this Case Study. Taking up this Endure task in such a collaborating way is an excellent start for future cooperation in European projects. Moreover, also non-Endure scientists contributed voluntary with additional information. They specifically, are gratefully acknowledged. Without their help, it would not have been possible to reach this very complete survey.

Appendix 1 Apple scab (Venturia inaequalis) research projects

In the table below on-going research projects are mentioned related to integrated control strategies. For easy access these are mentioned in alphabetical order of country and name of the institute. (no info = no information was submitted by the contacted person). (Prepared by K. Paaske, A. Patocchi, L. Parisi).

country	name institute	expertise	subject on-going research	project leader and/or contact person	contact to extension
Belgium	**Proefcentrum fruitteelt vzw**		micro climate conditions	ir. P. Creemers	yes
	research facilities	warning system	warning systems	piet.creemers@pcfruit.be	
	phytopathological laboratory	product activity	ascospore release	0032 11 586973	
	experimental fields	biological control		lic. K. Hauke	
	quarantine laboratory			kjell.hauke@pcfruit.be	
	climate rooms			0032 11 586974	
	greenhouses				
Belgium	**Walloon Agricultural Research Centre (CRA-W)**		breeding apple & pear	dr M.Lateur	yes
	research facilities	artificial inoculation	organic control	lateur@cra.wallonie.be	
	phytopathological laboratory	field research	systemic acquired resistance	0032 81620333	no
	experimental fields	diversity of strains		Ir L. Jamar	
	climate room	polygenic resistance		jamar@cra.wallonie.be	
	greenhouses			0032 81620333	
	orchard with scab race specific hosts			Ir B. Lefrancq	
				lefrancq@cra.wallonie.be	
				0032 81620333	
Denmark	**University of Aarhus, Faculty of Agricultural Sciences**		organic control	Klaus Paaske	yes
	research facilities	product efficacy	efficacy of products	klaus.paaske@agrsci.dk	
	Experimental fields	field research		0045 8999 3650	
	climate rooms in different sizes				
	greenhouses				

country	name institute	expertise	subject on-going research	project leader and/or contact person	contact to extension
Denmark	**University of Copenhagen, Faculty of Life Sciences (LIFE)**		use of botanicals	Marianne Bengtsson	no
	research facilities	botanicals culturing fungi	for apple scab control	mvb@life.ku.dk	
	growth chambers	in vitro assay	nitrogen nutrition &	0045 35 33 34 87	
	greenhouses	apple seedling assay	*V.inaequalis* infection process		
	classic phytopathological laboratory	inoculation			
	histopathological laboratory	host-pathogen interaction			
	biochemical laboratory	molecular studies			
	molecular laboratory	enzyme assays			
	advanced microscopy facility				
France	**INRA, Centre d'Angers, UMR PaVé**		resistance Durability	dr. B. Le Cam	yes
	research facilities	epidemiology	(adaptation of pathogen population	lecam@angers.inra.fr	
	Phytopathogy, molecular biology lab	pathology tests	to apple genotypes, construction	0033 241225735	
	Greenhouses	DNA techniques	and deployment of R genes)		
	Climate rooms	(MLMT, MLST)			
	Fields	modelling			
		fungi collection			
		control methods			
France	**INRA, Centre d'Angers, UMR Genhort**	apple breeding	resistance durability	Dr. CE Durel	yes
	research facilities	artificial inoculation	construction and assessment	durel@angers.inra.fr	
	molecular biology lab	field research	of resistant genotypes	33 (0)2.41.22.57.59	
	greenhouses	DNA-techniques e.g.			
	climate rooms	PCR, mapping of			
	fields	R-genes			
France	**INRA, UERI de Gotheron**		epidemiology	Dr L. Parisi	yes
	research facilities	epidemiology	biology	lparisi@avignon.inra;fr	
	phytopathological laboratory	integrated control	integrated control	0033 475599217	
	experimental orchards	warning systems		Dr L. Brun	
	climate rooms	sanitation		lbrun@avignon.inra.fr	
		cultivar mixtures		0033 475599204	
		partial resistance expression			

country	name institute	expertise	subject on-going research	project leader and/or contact person	contact to extension
France	**DRAF, Service Régional de la Protection des Végétaux (SRPV), Laboratoire**			M. F. Remuson	yes
	research facilities laboratory climate rooms in different sizes DNA laboratory	in vitro resistance tests biomolecular resistance tests	apple scab resistance to fungicides in laboratory tests (in vitro & biomolecular)	florent.remuson@agriculture.gouv.fr 0033 478631355 Mme A. Micoud annie.micoud@agriculture.gouv.fr Mme S. Fontaine severine.fontaine@agriculture.gouv.fr	
Germany	**Marktgemeinschaft Bodenseeobst e.G.**		pesticide dosing model	Peter Triloff	yes
	research facilities	warning system inoculum related control sanitation residual activity integrated control organic control	spray drift reduction	p.triloff@mg-bodenseeobst.de +49 (0)171 8298032	
Hungary	**University of Debrecen (DU)**	warning system	integrated control	dr. habil I.J. Holb	no
	research facilities experimental orchards basic laboratory facilities	modelling epidemiology disease management	organic cultivation and control	holb@agr.unideb.hu 0036 52 508444	
Italy	**Istituto Agrario San Michele all'Adige (ISAMAA)**		Plant microbe-interaction	Matteo Komjanc	no
	research facilities greenhouses molecular biology laboratory	DNA-techniques isolation of ssr, Norther and souther analysis mRNA study and PCR select analysis to mRNA differential sceening DNA sequencing	and apple-scab interaction	matteo.komjanc@iasma.it 0039 4616 15233	
Italy	**Research Centre for Agriculture and Forestry Laimburg**		integrated control	Marschall Klaus	yes
	research facilities climate rooms greenhouses phytopathological laboratory experimental fields	artificial inoculation product activity field research		klaus.marschall@provinz.bz.it + 39 471 969640 Rizzolli Werner rizzolli.werner@provinz.bz.it + 39 471 969642	

country	name institute	expertise	subject on-going research	project leader and/or contact person	contact to extension
Italy	**SafeCrop Centre, IASMA** **Research facilities** greenhouses phytopathological laboratory molecular biology facilities experimental orchards	DNA-techniques, e.g. PCR, Taqman biocontrol agents identification characterization, efficacy risk assessment decision support system	biocontrol	dr. Ilaria Pertot ilaria.pertot@iasma.it 0039 0461 615515	yes
Italy	**Università di Piacenza** **research facilities** greenhouses climatic chambers phytopathological laboratories experimental fields	epidemiology fungal ecology modelling integrated control	epidemiology and modelling warning systems integrated disease control	prof. V. Rossi vittorio.rossi@pc.unicatt.it 0039 0523 599253 dr. S. Giosuè simona.giosue@unicatt.it. 0039 0523 599252 dr. B. Girometta benedetta.girometta@unicatt.it 0039 0523 599252	yes
Italy	**University of Bologna** **research facilities** CMVF DCA Lab Cadriano Exp Station	Genetic resources of resistance Host pathogen mechanism	Scab control Resistant genotypes	Prof. S. Sansavini fruitseg@agrsci.unibo.it Dr. S. Tartarini startari@agrsci.unibo.it Dr. R. Paris rparis@agrsci.unibo.it	
Netherlands	**Applied Plant Research (PPO)** **research facilities** phytopathological laboratory experimental fields quarantine laboratory climate rooms in different sizes application technology	warning system modelling product efficacy field research climate room research artificial inoculation	organic control (EU-proj. Repco) sanitation practices efficacy of products	dr. B. Heijne bart.heijne@wur.nl 0031 488 473718 ir. P.F. de Jong peterfrans.dejong@wur.nl 0031 488 473745	yes

country	name institute	expertise	subject on-going research	project leader and/or contact person	contact to extension
Netherlands	**Plant Research International (PRI)**		biological control of apple scab	dr. J. Köhl	no
	research facilities	DNA-techniques, e.g.		jurgen.kohl@wur.nl	
	greenhouses	PCR, Taqman		0031 317 476017	
	quarantine laboratory	culturing fungi			
	classic phytopathological laboratory	antagonist			
	advanced laboratory	inoculation			
	DNA laboratory	epidemiology			
Netherlands	**Plant Research International (PRI)**		breeding cultivars with pyramided resistances	Dr. W.E. van de Weg	no
	research facilities	gene mapping	map based cloning scab resistance gene	eric.vandeweg@wur.nl	
	sources for genetic resistance	map based cloning	resistance gene pyramiding (cisgenesis)	0031 317 477281	
	sapping populations	scab resistance tests		Dr. H.J. Schouten	
	segregating populations	cisgenesis		henk.schouten@wur.nl	
	BAC library	markerfree GMO technologies		0031 317 477310	
	breeding selections	creation of BAC libraries			
	tissue specific plantal promotors	metabolomics			
	greenhouses	gene expression real time PCR			
	single spore isolates	bio-informatics team			
	micro-array facilities	proteomics			
	pyrosequencing facilities				
	colony picker (robot)				
	ABI-sequencing				
	proteomics facilities				
Norway	**Norwegian Institute for Agricultural and Environmental Research (Bioforsk)**	fungal biology	epidemiology	dr. Arne Stensvand	yes
	research facilities	yield trial evaluation	DNA marker application to check	hilde.nybom@ltj.slu.se	yes
	greenhouses	organic production	for type of scab resistance	0046 44 265802	
	experimental fields	DNA marker analyses	organic production methods		
	DNA lab	apple breeding			
	biochemical lab				
	fruit storage ULO chambers				

country	name institute	expertise	subject on-going research	project leader and/or contact person	contact to extension
Sweden	**Balsgard, Swedish Univ. Agricult. Sci.**		cultivar evaluation	Hilde Nybom	
	research facilities	yield trial evaluation	DNA marker application to check	hilde.nybom@ltj.slu.se	yes
	greenhouses	organic production	for type of scab resistance	0046 44 265802	
	experimental fields	DNA marker analyses	organic production methods		
	DNA lab	apple breeding			
	biochemical lab				
	fruit storage ULO chambers				
Switzerland	**Agroscope Changins-Wädenswil Research Station (ACW)**		integrated control of apple scab	Dr. A. Patocchi	yes
	research facilities	DNA- techniques,		andrea.patocchi@acw.admin.ch	
	greenhouses	molecular markers		+41 (0)44 783 6313	
	quarantine greenhouse	mapping of R-genes			
	classic phytopathological laboratory	epidemiology			
	DNA laboratory	apple breeding			
Switzerland	**ETH-Zürich, Institute of Integrative Biology, Plant Pathology**		identification avirulence/virulence genes	Prof C. Gessler	yes
	research facilities	host-pathogen interaction		cesare.gessler@agrl.ethz ch	
	greenhouses	mapping/cloning genes		0041 44 632 38 71	
	advanced DNA laboratory	transformation of apple		Dr. G. Broggini	
	phytopathological laboratory			giovanni.broggini@agrl.ethz.ch	
	climate rooms			0041 44 632 57 89	
UK	**East Malling Research**		fungal virulence genetics	Xiangming Xu	yes
	research facility:	warning systems	markers for mating types	xiangming.xu@emr.ac.uk	
	mycology lab	modelling	ascospore production		
	molecular lab	disease management	zero residues	Angela Berrie	
				angela.berrie@emr.ac.uk	
	glasshouse/controlled environment	epidemiology	elimination of primary inoculum		
	quarantine glasshouse	breeding	resistance breeding	+44 1732 843833	
	controlled growth cabinets	fungicide evaluation		Ken Tobutt	
	orchards	fungicide insensitivity		ken.tobutt@emr.ac.uk	
	CA store	fungal genetics		+44 1732 843833	
	breeding lines				

country	name institute	expertise	subject on-going research	project leader and/or contact person	contact to extension
UK	**Farm Advisory Services Team Ltd (FAST)**			Tim Biddlecombe	yes
	research facilities			tim.biddlecombe@fastltd.co.uk	
	experimental Fields	warning System product activity		0044 1795 533225	

Appendix 2 Codling moth (*Cydia pomonella*) research projects

In the table below on-going research projects are mentioned related to integrated control strategies. For easy access these are mentioned in alphabetical order of country and name of the institute. (no info = no information was submitted by the contacted person). (Prepared by D. Casado, J. Avilla, J. Samietz, B. Sauphanor).

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
Belgium	**PcFruit Gorsem Department of Zoology**		IPM (efficacy/side-effects)	Bruno Gobin	yes
	research facilities	population dynamics	population dynamics/interactions	bruno.gobin@pcfruit.be	
	experimental orchards	non-target arthropods	pests/beneficials	0032 (0) 11 58 69 68	
	access to private commercial orchards		sub lethal side-effects		
	climate chambers		toxicological evaluation for		
	breeding cages		non-target and beneficial arthropods		
	greenhouses				
	semi-field test cages (single tree, multi-tree)				
	flight cages (bee type)				
	Potter tower				
	Quarantine labs and greenhouses				
Croatia	**Faculty of Agriculture; Department of Agricultural zoology**		Integrated control	Bozena Baric	no info
	research facilities			baric@agr.hr	
	entomological laboratory	integrated control		0038512393746	
	experimental orchards	biological control			
	climatized greenhouse chambers	pesticide resistance			
Czech republic	**Crop Research Institute**		integrated control	Jitka Stará	no info
	research facilities	IPM codling moth	monitoring of insecticide resistance	stara@vurv.cz	
	climate rooms of different sizes	monitoring	CpGV in control	0042 02 33 02 23 33	
	entomological laboratory	CpGV application			
	experimental orchard				
	climatized greenhouse chambers				

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
France	**INRA Avignon** **research facilities** climate rooms greenhouses biochemistry / DNA laboratory wind tunnel, actometers experimental orchard orchard network	Insect resistance spatial dynamics environmental impacts	spatial dynamics resistance to chemical insecticides resistance to CpGV alternative control methods environmental impacts of protection strategies	Claire Lavigne clavigne@avignon.inra.fr 334 32 72 26 66 Benoît Sauphanor sauphano@avignon.inra.fr 334 32 72 26 07	no info
France	**INRA Gotheron Experimental Unit** **research facilities** experimental apple orchard systems (organic, IPM, supervised) experimental orchards (different management strategies and codling moth host plant)	IPM codling moth epidemiology	management regimes effect on orchard communities epidemiological studies	Sylvaine Simon simon@avignon.inra.fr 0033 475 59 92 21	yes
France	**INRA, UMR1272 PISC** **research facilities** climate room electrophysiology laboratory green house 4-way olfactometer large-size locomotion compensator access to confocal microscope access to wind tunnel access to molecular biology laboratory	insect olfaction	Interaction between pheromone and plant volatile compounds	Michel Renou michel.renou@versailles.inra.fr 0033 1 30 83 32 32	no info
France	**INRA Versailles** **research facilities** entomological laboratory orientation, locomotion measurement facilities green houses, climatic chambers trees in containers & orchard (INRA and others) GC for chemical analyses of metabolites egg laying test facilities on artificial substrate mass rearing insects (from INRA Le Magneraud)	plant resistance host-plant interaction	Plant resistance to codling moth by antixenosis, constituitive and induced apple tree resistance, plant surface signals and egg laying	Sylvie Derridj derridj@versailles.inra.fr 0033 1 30 83 31 64	no info

Country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
France	**DRAF, Service Régional de la Protection des Végétaux (SRPV), Laboratoire** **research facilities** entomological laboratory climate rooms in different sizes DNA laboratory		codling moth resistance to insecticides in laboratory tests (in vitro & biomolecular)	Mme C. Brazier christine.brazier@agriculture.gouv.fr Mme C. Mottet claire.mottet@agriculture.gouv.fr 0033 4 78631373 Mme A. Micoud annie.micoud@agriculture.gouv.fr Mme S. Fontaine severine.fontaine@agriculture.gouv.fr	yes
Germany	**BBA-Institute for Biological Control** **research facilities** insectaria/several colonies entomology laboratory insect pathology laboratory electron microscopy histology and diagnosis laboratory production and formulation laboratory greenhouse experimental field	biological control entomopathogenic nematodes & fungi	biological control entomopathogenic nematodes and fungi	Kerstin Jung k.jung@bba.de 0049 6151 407 237	no info
Germany	**BBA - Institute for Plant Protection in Fruit Crops** **research facilities** climate incubators entomological laboratory meteorological station experimental orchards climatized greenhouse chambers green houses	phenology IPM codling moth insecticide side-effects	flight activity/phenology integrated control side-effects of pesticides	Heidrun Vogt h.vogt@bba.de 0049 6221 86805 53 Annette Herz a.herz@bba.de	no info
Hungary	**Research Institute for Fruit growing in Budapest** **research facilities** Activity/mobility monitoring Experimental orchard	monitoring IPM codling moth	monitoring integrated control	Erzsébet Voigt e.voigt@dpg.hu 0036 (1) 362 15 96	no info

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
Italy	**IASMA Research Centre – Plant Protection Department**		plant-insect interaction	Claudio Ioriatti	yes
	research facilities	phenology	phenology modelling	claudio.ioriatti@iasma.it	
	climate rooms of different sizes	pesticide resistance	integrated control	0039 0461 615 514	
	entomological laboratory	IPM codling moth	pesticide resistance		
	wind tunnel and Y-olfactometer		pesticide registration		
	EAG, EAD-GC, SSR and SCR instruments				
	experimental orchards				
	multi-tanks air blast and tunnel sprayers				
	green houses				
Italy	**Università Cattolica del Sacro Cuore**		phenology modelling, integrated and	Fabio Molinari	no info
	research facilities	phenology	biological control	fabio.molinari@unicatt.it	
	climate rooms of different sizes	IPM codling moth	ecological behavioural biochemical and	0039 0523 599236	
	entomological laboratory	biological control	molecular basis of pesticide resistance		
	spectrofluorimeter	pesticide resistance			
	activity/mobility monitoring (wind-tunnel, olfactometer)				
Italy	**Università degli Studi del Molise, Dipartamento di Scienze**		larvae behaviour	Antonio De Cristoforo	no info
	Animali, Vegetali e dell'Ambiente	behaviour	peripheral interactions in the olfactory	decrist@unimol.it	
	research facilities	insect olfaction	perception of pheromone compounds	0039 (0) 874 40 46 86	
	Full-equipped entomology lab		plant volatiles in adults	0039 335 61 48 637	
	climatic rooms		olfactory response of		
	wind tunnels		host-races to sex pheromone		
	Y-shaped wind tunnel		and kairomones		
	air flow conditioning unit				
	olfactometers				
	electrophysiology lab (EAG, GC-EAD,SSR, SCR)				
Italy	**University of Bologna Dipartimento di**		integrated control	Edison Pasqualini	no info
	Scienze e Tecnologie Agroambientali	IPM codling moth	use of semiochemicals	epasqualini@entom.agrsci.unibo.it	
	research facilities	pesticide side-effects	side effects of pesticides on beneficials	0039 051 2096297	
	entomological laboratory	pesticide resistance	side effects of pesticides on other pests		
	experimental orchards	semiochemicals use	pesticide resistance		
	wind tunnel and olfactometer		improving pesticide applications		
	climatized greenhouse chambers				

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
Italy	**University of Molise Department of Animal, Plant and Environmental Science**		geostatistical methods	Pasquale Trematerra	no info
	research facilities	geostatistics	spatio-temporal analysis	trema@unimol.it	
	climate rooms	IPM codling moth	pheromone traps		
	entomological laboratory	alternative methods	landscape analysis		
	computers and software		precision IPM		
	experimental orchards		management of landscape		
			alternative methods		
Italy	**SafeCrop Centre, IASMA**		kairomones as control tools	Silvia Schmidt	yes
	Research facilities	insect rearing	IPM	silvia schmidt@iasma.it	
	insect rearing facilities	Insecticide reduction		0039 0461 615143	
	kairomone testing facilities	insect behaviour			
	experimental orchards	mating disruption			
Italy	**SafeCrop Centre, IASMA**		hyperparasite based control	Ilaria Pertot	yes
	Research facilities	insect rearing	(Hyssopus pallidus)	ilaria.pertot@iasma.it	
	insect rearing facilities	hyperparasite rearing		0039 0461 615515	
	kairomone testing facilities	insect behaviour			
	experimental orchards				
Netherlands	**Applied Plant Research PPO-Fruit Wageningen UR**		phenology modelling	Herman Helsen	yes
	research facilities	orchard IPM	integrated control	herman.helsen@wur.nl	
	entomology laboratory	epidemiology		0031 488 473754	
	experimental orchards	biological control			
	climate rooms	phenology			
Netherlands	**Plant Research International PRI (Wageningen UR**		pheromone production	Frans Griepink	no
	research facilities	pheromone identification	and development	frans.griepink@wur.nl	
	entomology laboratory	semiochemicals		0031317476169	
	electrophysiological equipment (EAG, GC-EAD etc)	monitoring			
	wind tunnel	mating disruption			
	analytical and synthesis laboratory	lure & kill			
	GC-MS, preparative GC, preparative HPLC	analytical chemistry			
	locomotion compensator	organic synthesis			
	head-space collection systems, also for soil volatiles				

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
Spain	**UdL-IRTA Centre de R+D**		insecticide resistance	Jesús Avilla	no info
	research facilities	pesticide resistance	mating disruption	jesus.avilla@irta.es	
	climate rooms of different sizes	mating disruption	host-insect communication	0034 973 70 25 81	
	entomological laboratory	insect communication	monitoring under mating disruption		
	activity/mobility monitoring	spatial dynamics	pest monitoring and geostatistics		
	full-equipped chromatography laboratory		communication inhibitors		
	electrophysiology equipment (EAG, GC-EAD, SSR)				
	wind tunnel				
	heated greenhouses				
	facilities for field trials				
	equipment for biochemical analysis of resistance				
	head-space collection systems				
	laboratory colony (since 1992)				
	Potter tower				
Switzerland	**Agroscope Changins-Wädenswil (AGROS)**		phenology modelling	Jörg Samietz	yes
	research facilities	phenology	integrated control	joerg.samietz@acw.admin.ch	
	climate rooms of different sizes	IPM codling moth	pesticide resistance	0041 44 783 61 93	
	entomological laboratory	pesticide resistance			
	activity/mobility monitoring				
	high-res. IR thermography				
	experimental orchards				
	climatized greenhouse chambers				
Switzerland	**ETH Institute of Plant Sciences, Applied Entomology**		plant volatiles and female behaviour	Silvia Dorn	no info
	Zurich	insect communication	parasitoids mobility and dispersal	silvia.dorn@ipw.agrl.ethz.ch	
	research facilities	parasitism	constitutive resistance of	0041 44 632 3921	
		plant resistance	apple genotypes, population studies with microsatellites.		

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
United Kingdom	**East Malling Research**		integrated control	Jerry Cross	no info
	<u>research facilities</u> climate rooms of different sizes entomological laboratory activity/mobility/dispersal monitoring experimental orchards climatized greenhouse chambers wind tunnel, behavioural assays EAG, GC-MS (through collaboration with NRI)	IPM codling moth semiochemicals	exploiting pheromones semiochemicals for monitoring	jerry.cross@emr.ac.uk 0049 1732523748	

Appendix 3. Brown spot op pear (*Stemphylium vesicarium*) research projects.

In the table below on-going research projects are mentioned related to integrated control strategies. For easy access these are mentioned in alphabetical order of country and name of the institute. (no info = no information was submitted by the contacted person). (Prepared by B. Heijne).

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
Belgium	**Trial centre Fruit growing**		DSS for the integrated control of brown spot	ir. P. Creemers	yes
	research facilities	warning system		piet.creemers@pcfruit.be	
	phytopathological laboratory	modelling		0032 11 586973	
	experimental fields	product activity		dr. S. van Laer	
	quarantine laboratory	field research		stijn.vanlaer@pcfruit.be	
	climate rooms	epidemiology		0032 11 586974	
	greenhouses				
Belgium	**University of Ghent**		DSS for the integrated control of brown spot	prof. M. Höfte	no
	research facilities	DNA-techniques, e.g.		monica.hofte@UGent.be	
	phytopathological laboratory	PCR, AFLP		0032 9 2646017	
	microbial biotechnology	culturing fungi			
		antagonist			
		epidemiology			
France	**DRAF Service Régional de la Protection des Végétaux; (SRPV) Laboratoire**		brown spot resistance	M. F. Remuson	yes
	research facilities	in vitro resistance tests	to fungicides with laboratory tests	florent.remuson@agriculture.gouv.fr	
	phytopathological laboratory	biomolecular resistance tests		0033 478631355	
	climate rooms in different sizes	biomolecular resistance tests		Mme A. Micoud	
	DNA laboratory			annie.micoud@agriculture.gouv.fr	

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
Italy	**Servizio Fitosanitario (plant protection Service)**		integrated control of brown spot	dr. R. Bugiani	no info
	research facilities	culturing fungi		rbugiani@regione.emilia-romagna.it	
	greenhouses	inoculation		0039 051 4159281	
	quarantine laboratory	epidemiology		0039 328 3804524	
	classic phytopathological laboratory	efficacy of plant protection			
	advanced laboratory	warning systems & modelling			
	experimental fields	field research			
Italy	**Universitat di Bologna**		integrated control of brown spot	prof. A. Brunelli	no info
	research facilities	culturing fungi		brunelli@agrsci.unibo.it	
	phytopathological laboratory	epidemiology		0039 051 2096546	
	advanced laboratory (fluorescent microscopy, protein analysis)	antagonist		dr. M. Collina	
	DNA laboratory	DNA-techniques (qualitative and quantitative PCR)		mcollina@agrsci.unibo.it	
	glasshouses	product activity		0039 051 2096566	
	climate rooms	(e.g. resistance to fungicides			
	experimental fields	field research			
Italy	**Universitat di Piacenze**		epidemiology & modelling of brown spot	prof. V. Rossi	yes
	research facilities	epidemiology	sanitation	vittorio.rossi@pc.unicatt.it	
	greenhouses	fungal ecology	BCAs	0039 0523 599253	
	climatic chambers	modelling	integrated disease control	dr. S. Giosuè	
	phytopathological laboratories	integrated disease control		simona.giosue@unicatt.it.	
	experimental fields			0039 0523 599252	
				dr. E. Pattori	
				elisabetta.pattori@unicatt.it	
				0039 0523 599356	
Netherlands	**Applied Plant Research (PPO)**		integrated control of brown spot	ir. P.F. de Jong	yes
	research facilities	warning system		peterfrans.dejong@wur.nl	
	phytopathological laboratory	modeling		0031 488 473745	
	experimental fields	product activity		dr. B. Heijne	
	quarantine laboratory	field research		bart.heijne@wur.nl	
	climate rooms in different sizes			0031 488 473718	

country	name institute	expertise	subject research	project leader and/or contact person	contact to extension
Netherlands	**Plant Research International (PRI)**		integrated control of brown spot	dr. J. Köhl	no
	research facilities	DNA-techniques, e.g.		jurgen.kohl@wur.nl	
	greenhouses	PCR, Taqman		0031 317 476017	
	quarantine laboratory	culturing fungi			
	classic phytopathological laboratory	antagonist			
	advanced laboratory	inoculation			
	DNA laboratory	epidemiology			
Spain	**Universidad de Girona**		integrated control of brown spot	prof. E. Montesinos	yes
	research facilities	warning system		emonte@intea.udg.es	
	phytopathological laboratory	modelling		0034 972418427	
	DNA laboratory	DNA-techniques		ir. I. Llorente	
	quarantine laboratory	strategies and products		llorente@intea.udg.es	
	climate rooms in different sizes			0034 972418939	
	greenhouses				
	experimental orchards				

Appendix 4. Background information given to non-Endure scientists

Background information for collecting information from non-Endure institutes to fulfil task1 “Survey ongoing integrated pomefruit research and facilities”

Endure
Endure is the acronym for Network of Excellence EU-project (No. 031499) with the full title: “European Network for the Durable Exploitation of crop protection strategies” (www.endure-network.eu). The operational goals of Endure are 1) to integrate relevant platform technologies and ongoing research initiatives in the network, 2) to reinforce the research and development capacities needed in Europe to reduce the use of plant protection products, 3) to promote the undertaking of collaborative research and spur interactions between researchers, industrialists, advisors, and farmers in the design and practical implementation of innovative crop protection strategies, 4) to progress towards a trans-national entity aimed at reducing pesticide inputs, 5) to establish Endure as a European centre of reference, and 6) to ensure the spreading of excellence, back training and education programmes.
In Endure 18 partners from 10 European countries and work together with 129 scientists and 55 PhD students to realise the Endure goals. The work plan consists of Work Packages concerning 1) Integrating activities, such as a) ensure long term strategy of Endure, b) creation of a virtual laboratory in crop-pest control, c) human resource exchange and d) integrated knowledge and communication, 2) jointly executed research activities, such as a) optimising and reducing pesticide use, which includes implementation of case studies, b) designing innovative crop protection strategies, c) multicriterion assessment of crop protection methods and cropping systems and c) improving the basic understanding of the biology of crop-pest systems, 3) spreading excellence activities, such as a) joint training and education programme, b) technology transfer, c) external dissemination plan and d) European Pest Competence Centre. The Case Studies act as a central activity for other work packages.

The **objectives** of the Pomefruit Case Study are to make progress in optimising and reducing pesticide use in pomefruit starting from existing farming systems by:
- Exploiting the current knowledge and integrated control strategies as well as available biological and technical resources to improve end-user implementation of methods or technologies not yet put into practice everywhere in Europe.
- Making better use of plant resistance and improved pesticide recommendations.
- Integrating these components into optimised crop protection strategies.

To realise these objectives information is collected about ongoing research and integrated control strategies already used locally in Europe. Assembling this information will result in a toolboxes containing:
- Information about what research institutes are working on integrated control strategies restricted to apple scab, brown spot and codling moth and their facilities.
- A diversity of integrated control strategies locally used in Europe for the mentioned diseases and pests.

With the aid of the toolboxes it is possible to better implement crop protection practices throughout Europe with a more optimum use of pesticides. Moreover, bottlenecks for implementation of integrated control strategies and gaps of knowledge will become evident. This opens opportunities for co-operation in applications for future EU-funded research projects.

Bart Heijne
Randwijk, 5 July 2007