ENDURE

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Orchard advisors analysis of possibilities to implement tools of integrated control strategies

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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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Glossary

Apple scab: A disease of apple caused by the fungus *Venturia inaequalis*. A related fungus *Venturia pirina* causes pear scab. Apple scab is one of the most important diseases of apple in the world where apple production takes place. The symptoms are dark brownish lesions on leaves and fruits and early leaf fall.

Brown spot of pear: A disease of pear caused by the fungus *Stemphylium vesicarium*. The overwintering sexual stage is *Pleospora allii*. The symptoms are rotting of fruits already in the orchard before harvest.

Codling moth: A pest of mainly apple but also pear caused by the tortricid moth *Cydia pomonella*. It is the most important pest of apple all over the world.

ENDURE: EU-funded project with the title “**E**uropean **N**etwork for **Dur**able **E**xploitation of crop protection strategies”

IFP: Integrated Fruit Production

Integrated control method: A method to control a pest or a disease which takes in consideration effects on environment and or natural control.

IP: Integrated Production

IPM: Integrated Pest Management; FAO definition: “Integrated Pest Control is a pest management system that, in the context of the associated environment and the population dynamics of the pest species, utilizes all suitable techniques and methods in as compatible a manner as possible and maintains the pest population at levels below those causing economic injury”

Pest: are all organisms that cause damage to agricultural crops in a broad sense; it includes mammals, birds, arthropods (insects, spider mites, etc.), weeds, fungi, micro-organisms and viruses.

Pos: Producers

Summary

Implementation of integrated control tools into orchards systems was investigated and analysed. For that purpose two sources were used. First, the Endure deliverable DR 1.8 & 1.9 “Survey and analysis of the state of art of scab, brown spot and codling moth prevention and control strategies” and the deliverable DR 2.7 “Inventory and analysis of possible social and economic bottlenecks to implement integrated control tools”. And secondly, the European fruit advisors opinion was used as a source, as it was expressed during a RA2.5 meeting at in Wädenswil, Switzerland at 5 – 6 February 2009.
Three different approaches were used to analyse implementation of integrated control tools into practice: social, economic and technical approach. The major conclusions became prominently visible. The major conclusions are:

1. Reliability
   Growers strongly weigh the reliability of new integrated control tools against that of the use of pesticides. Often, their perception of the reliability, or the objective reliability on the new integrated control tools is lower than that of pesticides. Growers balance the yield risks with control strategies and pesticide availability.
2. Efficacy
   Growers are used to the relative high efficacy of pesticides. The majority of the new integrated control tools are less effective, or has to be repeated more times, or takes much more labour than the efficacy, frequency or labour efforts of pesticides.
3. Economy
   Very often the new integrated control tools are more expensive than traditional use of pesticides.
4. Differences in perception of IFP
5. Role of supermarkets
   Supermarkets don’t pay attention to IPM as such, but are interested in maximum residue levels (MRL’s)
6. Advisors
   Advisors are not really willing to advice on advanced forms of IPM because they don’t have commercial demand for it from the growers, because they have commercial interests to new contracts with growers.

It is recommended to focus technical research on providing solutions to improve reliability, efficacy and economic aspects of the new integrated control tools. Social and institutional adjustments are needed to promote IPM implementation. Endure should reflect on the roles of policies and policymakers as well as technical improvement, efficacy and economy in this respect.

Teams involved:

Teams of the following institutes were involved in achievement of this deliverable. They are Endure participants, but also none-Endure partners, mainly fruit advisors organisations.

Institution	country	Extension Service
Aarhus University	DK	
ACW	CH	
ART	CH	
ART	CH	
DLV Plant Extension Service	NL	yes
Extension Service South Tyrol	IT	yes
Fruitconsult	NL	yes
GRCETA	F	yes
IBMA,	CH	
INRA-Avignon	F	
INRA-Cotheron	F	
INRA-Grignon	F	
JKI	D	
KOB- Bavendorf	D	yes
MABO	D	yes
MNHN / Aarhus University	F	
Plant Protection Service – Emilia Romagna Region	IT	yes
Plant protection service SG and TG	CH	yes
Plant Protection Service, Government of Aragon	SP	yes
UdL, University of Lleida	SP	
WUR/LEI	NL	
WUR/PPO	NL	

Geographical areas covered:

The input on which the analyses were based, originated from nine European regions, which in some cases were similar to countries. These were: north of Spain (Catalunia & Aragon), the Netherlands, Switzerland, Emila Romagna (Italy), Denmark, Lake Constance, both the German and the Swiss region, Rhone Valley (France)

Degree of validation and operability of findings:

It is believed that the findings described in this deliverable are valid through a large part of Europe and for certain in western, northern and southern Europe. There are no specific reasons to believe that the findings will substantially differentiate in Eastern Europe. The findings are directly related to the practical farmers' level.

1. Orchard advisors analysis of possible bottlenecks to further implement tools of integrated control strategies

It was found that possible bottlenecks hindering further implementation of integrated control tools into orchards systems can be of substantially different nature. During a meeting held with a group of European fruit advisors technical, economical and social arguments were mentioned. In this document an analysis is made of the most important ones. The Endure deliverable DR1.8 &1.9 "Survey and analysis of the state of art of scab, brown spot and codling moth prevention and control strategies" was distributed among the fruit advisors as back ground information about implementation of integrated control tools in different regions in Europe, other than their own. As a consequence, the analysis was made with emphasis, but not restricted to, the pest and diseases, codling moth (*Cydia pomonella*), brown spot of pear (*Stemphylium vesicarium*) and apple scab (*Venturia inaequalis*).
The following chapters are separately devoted to 1) social and economical analyses, 2) crop protection economics; balancing yield risks and control strategies and 3) technical analyses.

1.1. Methods used

Of major importance for the analyses was the meeting with fruit advisors from different regions in Europe. In discussion sessions their opinion was asked and clarified. Separate sessions were held for socio-economic and technical aspects.
Participants, fruit advisors and researchers, were given the deliverable DR 1.8 & 1.9 "Survey and analysis of the state of art of scab, brown spot and codling moth prevention and control strategies". Information on the degree of implementation of IFP methods from this deliverable appeared most helpful in the discussion with both the fruit advisors as well as the analyses of possible bottlenecks for implementation of integrated control measures.

2. Socio-economic analysis

by Isabelle Haynes (INRA Grignon)

2.1. Introduction

Social and economical bottlenecks for the implementation of Integrated Fruit Production (IFP) in the pomefruit orchards have been identified by RA3.5 and RA2.5 researchers and described in the deliverable DR 2.7 "Inventory and analysis of possible social and economic bottlenecks to implement integrated control tools". In this deliverable, the degree of implementation of IPM methods was identified for different regions in Europe. And possible bottlenecks to further implement these IFP methods were identified. Following this first step, our objective was to discuss these bottlenecks and drivers with the advisors from various EU countries in order to analyse their perceptions and explore the nuances that they (who are confronted daily with the growers' needs and demands) could introduce.

2.2. Methods

2.2.1. Set-up

Four main themes had been distinguished and discussed by researchers.

- Bottlenecks/drivers linked to work organisation. For example, the growers' agenda was so full that they couldn't spray at the best time.
- Bottlenecks/ drivers linked to the collective organisation of farmers. For example some Producers Organisations in France hire an employee who monitors all the PO members' orchards during the season.
- Bottlenecks/drivers linked to the market. For example, it seems very difficult to find market opportunities for resistant cultivars, because of other cultivar specific properties.
- Bottlenecks/drivers linked to the producers themselves. Particularly the state of training in alternative techniques.

These themes were discussed with the advisors, who did attend the RA2.5 Orchard System Case Study meeting in Wädenswil (CH) on Feb, the 5th 2009. As the first part of the meeting, animated by WUR/PPO, was dedicated to discussions about technical bottlenecks, we, as social scientists, animated a workshop focused on socio economical bottlenecks. However, when technical elements mentioned in the first part of the meeting with advisors can complement the analysis, we will refer to them.

The following advisors did attend the workshop:
- Carlos Lozano. Plant Protection Service from the government of Aragon (Spain)
- Martin Trautmann. KOB Bavendorf (Germany)
- Peter Triloff MABO (Germany)
- Pascal Borioli. GR CETA de Basse Durance (France)
- Henry Balkhoven. Fruitconsult (NL)
- Pieter Aalberts. DLV Plant (NL)
- Richard Hollenstein, Plant protection service SG (CH)
- Riccardo Bugiani and Alda Butturini (Emilia Romagne Region) (IT)
- Robert Wiedmer Extension service South Tyrol (IT)

Moreover, two people from the Bio control industry were also present: Bernard Blum from IBMA and Vittorio Veronelli CBC (Japan/Italy).
After a presentation of the method, we will detail the analysis of the meeting results.

2.2.2. Method

Before the meeting, a questionnaire was sent to the advisors (see appendix 3). Its aim was to better know their work context and to have a first idea of their perception of the IFP issue. Five advisors out of ten returned the questionnaire. During the meeting each of the four themes was introduced by a power point slide (see appendix 4) with:

- A sentence taken out from the verbatim of a producer or of a researcher. Its aim was to draw the context of the discussion.
- A couple of questions for launching the debate.

The meeting lasted an hour and a half. The discussion was recorded and notes were taken by the social scientists that attended the meeting i.e. Jan Buurma (LEI Wageningen UR) and Julien Blanc (AU) while Isabelle Haynes (INRA Eco Innov) was animating the debate.
All the advisors that attended the meeting were experienced ones with a minimum of 15 years of work as advisors. They establish long term relationships with the growers as they were all supervising the same group of growers from a minimum of 4,5 years to a maximum of 18 years but there is a big difference in the amount of growers that are supervised: from 25 to 650 .
➔ This first element introduces a bias for the interpretation of the results as younger and/or less experimented advisors might have a very different perception of the issue at stake. This might be overcome by longer training programs of young advisors.

The average farm size under supervision by advisors varies a lot: from 10 to 300 ha with examples of 1 or 2 ha orchards in Spain and France.

2.3. Results

After analyzing the advisors' conception of IFP, we will focus on the four themes derived from the analysis made by scientists.

2.3.1. Advisors conception of IFP

The advisors use of the term IFP refers to a basic set of practices aimed at optimizing pesticide use and replacing pesticides by alternative tools when they are not available anymore (because of regulation or because of resistance of pests to pesticides). Reference to IFP is never done as a mean to move to a different type of farm management.

IFP is not perceived as an operative concept but rather as a scientific one. Most advisors acknowledged that they never refer to the concept of Integrated Protection when talking to the growers because they are in an immediate problem/solution type of thinking within a high yield production scheme. "*We don't talk a lot about IFP. We talk about producing lots of fruit for a low price".*

Advisors are doing tradeoffs between the economic /marketing objectives of their clients and the environmental impacts of pesticide use that is reflected, for example, in the description of a "well kept orchard" given by many of them such as: "*Sustainable plantation of tree in a good physiological balance, minimum environmental effects, low residues in crops and high financial output*". This understanding of IFP refers to the implementation of Good Agricultural practices never to the (re)design of the crop system. As one of the participants said*: "(only) organic producers have to think in terms of strategies as producers working with IFP don't need to do so because they still have chemical solutions".*

Even if they don't talk about it with growers, some advisors have personal precise ideas of the indicators that should be used for assessing the progress of IFP implementation in the orchards. First of all, they consider the treatment frequency index as non-performing as it doesn't say anything on the general amount of toxic products that have been displayed on the orchards.

They suggest using the following indicators instead:
- Number of orchard with mating disruption
- Number of untreated orchards

But we can notice that both of these indicators should be completed by surface information that would give a more precise idea of the extent of IFP implementation.
- Number of diseases treated
- Number of pests which are partly controlled by beneficial organisms in the orchard
- Amount of residues

Against this background, a main bottleneck to IFP within the actual growing system is the rise of pesticide resistances which drives many growers and advisors to adopt preventive chemical strategies that lead to increasing the number of sprays instead of using alternative tools. However, as the French advisor said, when a yield is threatened, the grower will use all available tools to protect his/her orchard including alternative strategies.

Other general bottlenecks are linked to the structure of advisory systems. It was said that:
- Advisory systems that provide a whole service to the farmer (with advice on fertilization for example) and some work agenda outlines can influence the growers' work organisation for the best (advice that spraying might not be necessary) or the worse (safety sprays).
- When advisors are specialized on plant protection and give an advice that growers can balance with other information; the perception of some advisors is that, in this case, monitoring of pests and diseases makes growers more aware/afraid of the yield risks. Such a situation may induce increases in spray frequencies all the more so as growers might lack of some information or be isolated. Furthermore techniques such as sanitation (leaf shredding and mulching) may damage soil structure and grass strips (resulting in higher weed densities) and consequently requires a broader approach, which is not always compatible with specialized advice on Plant Protection.
- Advisory systems are assessed by growers according to the outcome of their advice. It was mentioned in RA3.5 previous contribution that, in privatized systems, this might lead to increased recommendations for pesticide use as the yield has to be protected at any cost.

But another interesting aspect is the growers' asymmetric perception of alternative strategies. As a participant said "*failure with alternative tools will never be forgiven while failure of a chemical will be more easily forgotten*". In other words alternative control methods are still considered by growers as risky business and the advisors are very aware of that. For example, in the NL an advisor mentioned that trust in the efficiency of mating disruption was lost as growers have been experimenting losses a couple of years ago.

2.3.2. Analyzing the four themes issued from the scientific analysis of social bottlenecks

2.3.2.1. Work organisation

This bottleneck was conceived by advisors as the elements that prevent growers to adopt the best spraying agenda i.e. an agenda that would be flexible and tuned according to orchard monitoring observation and DSS information.

A common bottleneck is linked to weather conditions: in many Spanish areas for example, the wind blows so strongly that spraying when it would be the best is not possible.

In the other cases a difference has appeared between large orchards (≥25 ha) and smaller ones.

<u>a) In the countries with large orchard surfaces</u> the constraints linked **to labour management** prevent the adoption of an optimized spraying agenda.
In Southern France, with an average surface of 25/27 ha, growers need non-family workers. They have to deal with the regulation that limits weekly working hours to 35 hours (one hour of labour costs13 €). Which means that, in many cases, the grower is going to plan the work agenda in a way that minimizes the amount of extra hours to be paid to the staff i.e. the treatments will be scheduled within the legal working hours whatever the state of the orchard. But it was also said, the less labour force per hectare, the less flexible spraying agenda.
In France and Italy, another situation that can be encountered is that setting up pheromone dispensers might turned out to be necessary before the beginning of the season when the labour force (which is often hired on a season basis) is lacking. Therefore the work is not done on time as it is very time consuming.

<u>b) In the countries with smaller orchard surfaces,</u> growers don't use non-family labour force. Bottlenecks to a tuned spraying agenda are linked to a time **management issue** which can take various aspects:

- Growers can work only part time on their farm and have another occupation (ex: Aragon in Spain) which makes them spray whenever they can. Furthermore those farms are often underequipped which doesn't allow to work on short lengths of time that would be necessary to get the best results.
- Growers have so much other things to do (all the more so as when they have other crops) that their plant protection activity is not always a priority. They spray when they can.

Finally, some growers follow the advice given by the advisory services and don't take time to think about the issue by themselves and don't confront the advice that they receive (by fax or internet) to the reality of the orchard state. This lack of capacity to react in front of problems and to analyse the consequences of treatments is also underlined by the French advisor as an important bottleneck to be overcome.

However **some drivers** were also identified

- A representative of a bio control company has mentioned that the adoption of Integrated Control methods should reduce the cost of the farm management because it reduces the number of sprays. Such an analysis was contested by the advisors because the gain is absorbed by the (labour) cost of monitoring.
- A main driver for change is considered to be improving the training of the staff. In many cases the staff has a basic training but lacks of knowledge about IFP tools. Therefore elements such as the staff rotation and time dedicated to training should be important to assess the farm's capacity of change. This brings additional costs to be spend by to orchard owner.
- Another driver would be the development of techniques allowing a more precise management. As an advisor said: "*If there was a tool that would allow assessing yield efficiency and fruit weight, it would lead to minimizing water, fertilizers and pesticide use"* May be DEXiPM (or DEXiOS) could fill this gap.

2.3.2.2. Collective organisation

The debate around the impact of collective organisation on the adoption of IPM was quite lively. It drew a line between advisors from the Mediterranean countries (France, Italy, and Spain) where forms of collective organisations are accepted and often widespread and Northern EU countries where farmers were said to be more individualistically organized. Even when collective organisations such as market oriented groups exist, as in the NL, plant protection was never an issue shared by the growers even if they might talk informally about it. For example, from epidemiological point of view, this might be important for further implementation of IPM methods.

The debate was centred on the sentence quoted in the power point presentation i.e. «The Producers Organisation pays the wages of the guy who goes into the orchard to monitor the pest pressure»**.** This example was taken out from a verbatim of a previous study and raised lots of comments about the role to be given to this person: could he/she be monitoring and advising or should he/she be monitoring only?

For the Northern EU advisors, the very fact that people specialised in monitoring exist and that they are paid by the Producers Organisations were news in itself. It seemed acceptable that the person should be in charge of monitoring but not in charge of decision making. To the opposite cumulating both tasks was considered as something that would play against IFP because this person would tend to advise for more control and more spray in order to protect oneself against bad work assessment from the growers. Northern EU advisors paid a lot of attention to the fact that the grower is ultimately responsible for what is done in his/her orchard and they advocated against any transfer of responsibility from the grower to the advisor.

For Mediterranean countries advisors combinations of both tasks are frequently encountered (in France both tasks can be separated or cumulated). For example, in Aragon, some IP groups of growers were created in the 80s sometimes within cooperatives but not always. According to the Spanish advisor they did very well for the implementation of IFP. They hired pest control advisors, the wages of whom were partially funded by the regional government (20 to 30 %). This last element was the first reference to the importance of policy tools for influencing growers' practices.
Anyway, collective organisation was said to be a good way of allowing an area wide approach which has turned out to be an efficient tool for managing alternative control strategies.
De facto, it was possible to link this statement with the statement made by Spanish scientists during the first part of the Wädenswil meeting, according to which the positive outcomes of a collective organization of mating disruption is, for example, that the orchard located at the centre of the area don't need any pesticide anymore.

From the discussion it is clear that both the northern and southern concepts have advantages and disadvantages. The use of monitoring itself is undoubtedly useful, however the following advice based on the monitoring results, might be organised in different ways. And it is unclear if this influences possible bottlenecks for further implementation of IPM.

2.3.2.3. Markets

The power point was referring to a verbatim from the DR 1.8 report which mentioned: "(The variety) Topaz has potential for farmers doing direct commercialization". This sentence was introducing both the issue of the commercialisation of resistant cultivars (which was mentioned as an important issue in the scientists' perception of bottlenecks) and the issue of the impact of the retail circuit. It was the opportunity to launch a discussion about new forms of marketing strategies such as the marketing "clubs" created for the resistant cultivar Ariane in France or for pest sensitive varieties such as the Pink Lady.

a) Alternative marketing/retail forms. The Dutch advisors was the only one to refer to marketing clubs created for the promotion of new varieties like Kanzi, Junami and Rubens, but he didn't have any more comments to make on it.
However, as a French scientist mentioned in the previous meeting, it would take twenty years to replace the existent orchards by apple scab resistant ones, and, within that period, the resistance might well be bypassed.
The French advisor mentioned that the limit to the multiplication of varieties and the use of marketing club was the supermarkets fruit shelves themselves because their length were limited.

When discussing alternative retail circuits, the general advice seemed to be that they could only be secondary strategies.
From one side an advisor mentioned that the quantity of apples that are produced is so important that local retail or direct sale were not enough to absorb the whole production. From the other side, further development of direct sale was to be considered when the diversification of varieties (introduction of new varieties/ reintroduction of old cultivars) was at stake.
The French advisor mentioned that, even though most of the consumption is price led, some consumers were interested in the work of the growers. These consumers were ready to buy less known varieties. In a previous conversation, the same advisor mentioned that because of transportation constraints, firmness is demanded by supermarkets and firmness goes against taste as it requires early harvesting i.e. less sugar. Therefore a way to promote fruit consumption could also be the direct sale of more sweet tasty fruit, and a “quality” label which allow higher selling prices.
However, in all cases, most producers have no direct contacts with consumers. The demand they face is the demand coming from supermarkets or wholesalers and it remains their main concern. According to the Northern Europe advisers, the supermarket demands are like asking for a sheep with 5 legs because fruit have to be altogether, cheap, unsprayed and nice looking, which by itself is a “contradictio in terminis”.

b) Impact of supermarkets demands on IFP
The supermarkets were said to have no interest in IFP. What matters is the residue limit and supermarkets impose a strong commercial pressure, all the more so as NGOs (such as Greenpeace in Germany) are very active on this issue. A debate opposed the representative of the bio control industry who states that alternative method can contribute to the achievement of less residues and the French advisor who states that this is true to the condition that alternative methods are registered and authorized in the country which is not the case in France for many bio control tools. This is a big limiting factor.
Therefore facilitating the registration process and the legalization of alternative methods is important but, as it is left to each country’s leadership (EU only authorizes the active molecules but not the end products) the discrepancy between countries for achieving better IFP increases. This issue was also abundantly commented during the technical debate with advisors.
It was noticed that the stiffening of the regulation has led growers to implement bypass strategies. For example, when copper was forbidden, growers replaced it by fertilizers which contained copper and were used as pesticides. This is now impossible with the new EU regulation.
Moreover, German supermarkets demands are perceived to creating a counterproductive situation. Supemarkets are competitors among them and acting individually. Some of them are said to demand a maximum of four measurable residues per fruit while others demand no residue at all. This is all the more demanding that analysis techniques now allows the detection of very small concentration levels that couldn’t be isolated before. It leads growers to reduce the number of molecules they use, hence contributing to the development of pest/disease resistances against plant protection products.
Finally, advisors perceive that the supermarkets’ take organic production as an ideal but such ideal can’t be generalized. For example, a German advisor stated that, according to a recent German study, achieving the same apple production level with organic techniques would require an extension of the cultivated areas by 70 %.

2.3.2.4. Producers’ knowledge/capacity

The objective was to talk about non-economic drivers to the adoption of IFP. The issue of the IFP definition was raised again as Swiss or German advisors considered that there was no other solution for growers than to get involved in basic IFP. However an advisor said “Its’ easier to spray than to think” which drew the attention to the issue of reasoning one’s practices and/or learning. This might be partly implemented by legislation/regulation.

From the advisors side, there are frequent relationships with advisors from organic agriculture which is a source of constant knowledge exchange. This exchange is more or less formalized and can go from regular meetings with organic advisors (Rhône valley) to informal meeting at the office. Some advisors work in both fields: IFP and organic. This is not always the case at growers' level (see previous DR3.5 report). Advisors also follow training activities and participate in specific meetings organized once or twice a year.

At growers' level, there is sometimes no interest in a pest that doesn't cause an important threat to the production (e.g. codling moth in the NL). In France it was said that in the past 15 years, growers have embodied IFP techniques and that they are now looking for the opportunity to implement new techniques (which raises again the regulation issue)

De facto, further involvement of growers in the path to Integrated Fruit Production and Protection was linked to:

- Access to knowledge.
  - For example in France in the past, many orchards are transmitted from father to children who don't receive a specific training or education in making the production more sustainable. This is now gradually changing.
  - Knowledge access for the labour force and the growers' capacity to delegate the work to be achieved and to make the staff feel responsible was also mentioned.
- Interest in the Plant Protection issue. An advisor mentioned that growers are often interested in specific issues such as plant protection, crop management or pruning for example. They get very advanced in one of these subjects and gain more experience and go further than what is recommended by the advisors. However it is a matter of personal interest.
- Creation of incentives. Using IFP is often perceived by growers as constraints because they never obtained any incentives to change their practices. This is an important issue.

For example a representative of the bio control industry suggested integrating IFP in the EU Certification of Origin schemes or at least labelling production strategies. Linking the quality of production with the origin would create a reward for the growers.

In every case, it was acknowledged that training programs targeting IFP issues have been part of the countries' policies but that they were one shot programs which is contradictory with the idea of a progress path to Integrated Production that shouldn't be stopped. For example, in the 90s, all Dutch growers did receive training but the program lasted only five years with no follow-ups. Newcomers and evolutions in IFP are not taken into account.
Similarly, in Germany, one shot programs were organised for example to learn how to recognise pest in winter times but that was stopped also. The question arises: "what are the possibilities to have permanent training programs?"

2.4. Conclusion

If we refer to the JPA3 work about the analysis of current (CS), advanced (AS) and innovative systems (IS), the testimony of the advisors suggest that most of the production that they supervise can be framed in the Current System of fruit production. De facto, Integrated Protection is perceived as a constraint to be dealt with within the current production system and pesticide use is still the first option that is considered. However, it seems that some growers combine different integrated tools hence reaching an advanced form of IFP. Against this background, the main drivers and bottlenecks discussed by advisors, that we have just detailed, can be summarized in Table 1.

Referring both to this table and to the suggestions of IFP indicators given by the advisors we can suggest the following data to be included as parameters for the assessment of Current and Advanced Systems.

Elements linked to the agricultural practices:

- Number of orchards with mating disruption,
- Number of untreated orchards,
- Number of diseases treated,
- Number of pests controlled by beneficial organisms in the orchard,

Elements linked to supermarket constraints

- Specific MRL's constraints
- Specific skin quality (smoothness, russet, and colouring)
- Percentage first class fruits

Both of these exist already in a general version in the DEXi model for arable crops but adaptation to this specific aspect of orchard cultivation should be considered.

Table 1. Advisors vision of drivers and bottlenecks to IFP identified by scientists.

	Drivers	Bottlenecks
Advisory systems	Advisory systems targeting the whole farm work provides work agenda outlines that can be both positive or negative	
		Risk adverse /specialized in plant protection advisory system
		Asymmetric perception of the risks linked to pesticide use and of those linked to alternative strategies
Work organisation		Labour costs influence work planning
	Training of staff	Labour non available
	Precision assessment techniques.	Growers only work part time on the farm
		Lack of capacity to react in front of problems
		Competition between operations
Collective work organisation	Support labour cost	Precaution strategies
	Geographical organisation for mating disruption	Small size of plots
Markets	Marketing clubs	Supermarkets restrictions on the number of residues
	Direct sale circuits with less emphasis on skin aspect and firmness	Size of the supermarket fruit shelve
	Linking IFP to Protected Designation of Origin	No idea of the consumers demand
Regulation	Limitation of the molecules allowed	Discrepancy in the bio control products authorized at national level
Producers situation		Lack of training due to family transmission of orchards
		Grower unable to delegate work
Public Policy		Short term /one shot programs

As far as social criteria are concerned, some of them had already been included in the DEXIPM tree as a result of the work done by RA3.5 in the JPA1, which means that their value as social criteria is confirmed by the discussion with advisors. However, some of them could be refined:

Social Criteria already included in DEXIPM:

- Type of advisory system
- Competition between operations
- Level of qualification of workers
- Level of permanent work. Following, the advisors' advice, it could be interesting to explore the links between the availability of labour force, its qualification and the competition between operations.
- Level of complexity of work
- Belongingness to farmers group
- Belongingness to other networks
- Innovative farmers groups
- Transmission. This parameter was understood as a bottleneck to the extent that growers could be discouraged to change their practices if they had no perspective for transmitting their farms. To the opposite, advisors underline that transmission is sometimes made with no specific training and that can turn into a bottleneck.
- Type of marketing contracts
- Number of direct sale schemes

We could also add

- **Grower status**. One's status as a part time grower (with an extra farm occupation) or full time one has impacts on the setting up of the spraying agenda, the farm equipment and the time dedicated to training.

And, in the economic parameters:

- Existence of public policy schemes. They can take different forms such as direct payments, or subsidies to learning programs for example.
- Duration of public policy support
- A study of the links between labour cost and work planning

Summarizing, having in mind that the DEXIPM model is not necessarily grounded on quantitative data but can also be fed by expertise, we can put in parallel, the drivers and bottlenecks identified by the advisors and suggest the corresponding "parameters"(Table 2). When these drivers and bottlenecks are linked to the growers' psychology, we chose to keep record of them.

Table 2. Drivers, bottlenecks and suggestions for DEXIPM parameters. The first two columns should be read vertically. There is no horizontal correspondence between drivers and bottlenecks.

	Drivers	**Bottlenecks**	**Parameter**
Advisory systems	Centralised advisory systems provides work agenda outlines that can be both positive or negative		Type of advisory system
		Risk adverse advisory system	
		Growers' perception of IFP as more risky than chemicals	
Work organisation		Labour cost influence work planning	Labour cost
	Training of staff	Labour non available	Level of permanent work Level of qualification of workers Level of complexity of work
	Precision assessment techniques.	Growers only work part time on the farm	Grower status Level of equipment
		Lack of capacity to react in front of problems	
		Competition between operations	Competition between operations
Collective work organisation	Supports labour cost	Precaution strategies	Public Policy Belongingness to farmers' groups
	Supports geographical organisation for mating disruption	Small size of plots	Average plot's size
Markets	Marketing clubs	Supermarkets limitations on the number of residues	Existence of restrictions vs. official MRL's
	Direct sale circuits with less emphasis on skin aspect and firmness	Size of the supermarket fruit shelve	Type of marketing contracts Existence of a certification Nb of direct sale schemes
	Linking IFP to Protected Designation of Origin	No idea of the consumers demand	
Regulation	Limitation of the molecules allowed	Discrepancy in the bio control products authorized at national level	Nb of authorized products per country
Producers situation		Lack of training due to family transmission of orchards	Transmission
		Grower unable to delegate work	
Public Policy		Short term /one shot programs	Existence of public policy Duration of public policy support

3. Crop protection economics; balancing yield risks and control strategies

by Jan Buurma (WUR/LEI)

3.1. Introduction

This working paper describes the results of a North-South gradient analysis of the control strategies for codling moth *(Cydia pomonella)* and scab *(Venturia inaequalis)* in apples.

During the ENDURE – RA2.5 meeting with fruit advisors in Wädenswil (5th February 2009) a difference in perspective between researchers and advisors came to light. Researchers wanted to know why IPM techniques like mating disruption, granulovirus and sanitation have such a low acceptance in practice. Advisors once and again answered, that fruit growers can handle codling moth and scab with the existing control strategies; they don't switch to new and expensive techniques as long as the necessity does not exist.

The answers of the advisors underline, that fruit growers are continuously balancing yield risks and control strategies. They don't take a sledgehammer to break a walnut. In economic words: the costs of the control strategy should not exceed the expected yield loss. This rationality was also found in a study on differences in scab control among apple growers in the Netherlands (Buurma; 1997). The study concerned showed clear correlations between yield losses faced at farm level, risk perception of the grower and intensity of fungicide use.

The hypothesis is now, that pest/disease severity and yield/quality losses of codling moth and scab might be different between climate zones in Europe, and -as a result- the control strategies in the various fruit production regions should also be different. The hypothesis is tested with the information on "the state of art of scab, brown spot and codling moth prevention and control strategies" reported in ENDURE Deliverable DR1.8 & DR1.9.

The results of this working paper provide important inputs for ENDURE sub-activity RA3.2 on "Socio-economic driving forces of crop protection strategies", for the discussion on economic criteria in ENDURE sub-activity RA3.4 on "Life Cycle Assessment". Last but not least the analysis provides a contribution from the economic discipline to the socio-economic analysis of possibilities to implement tools of integrated control strategies (ENDURE sub-activity RA2.5; Deliverable DR2.7). It also provides a conceptual framework for the European network of fruit advisors (ENDURE sub-activity RA2.5; Milestone MR2.10).

3.2. Analysis results codling moth

Annex 1 provides a compact summary of the information on codling moth integrated control strategies compiled in chapter 2 of ENDURE – Deliverable DR1.8 & DR1.9. The summary shows a ranking from fruit production regions from south (Lleida) to north (Sweden). For each production region the main characteristics (apple acreages, codling moth severity) and control strategies (monitoring, forecasting, mating disruption, etc) are specified.

The Annex 1 shows a decreasing number of codling moth generations when travelling from south (Lleida; 2.5 generations) to north (Sweden; 1.0 generations). Simultaneously the efforts for monitoring (pheromone traps, fruit damage assessment) are decreasing. The application of mating disruption and the occurrence of pesticide resistance problems is also decreasing from south to north. Pesticide choice is also changing when travelling from south to north. In the south (Lleida through Emilio Romana) mating disruption in combination with alternation of different modes of action is applied to keep codling moth under control. Around

the Alps (South Tirol through Lake Constance) one single control strategy (mating disruption or IGRs) seems to be enough for codling moth control. In the northern regions (The Netherlands and Sweden) mating disruption on its own is not enough reliable in situations with high infestations. Therefore different types of methods and pesticides are alternated to control codling moth.
The patterns described in the previous section support the hypothesis that fruit growers are balancing expected yield losses against control strategies. In the southern fruit production regions codling moth has 2 – 3 generations annually and consequently causes bigger yield loss risks than in the northern regions where 1 generation applies. In the southern regions the risk is further increased by insect resistance against pesticides. As a result growers and advisors in southern regions spend more time and effort to monitoring, mating disruption and pesticide applications in order to keep codling moth populations at acceptable levels.

3.3. Analysis results apple scab

Annex 2 provides a compact summary of the information on apple scab integrated control strategies compiled in chapter 4 of ENDURE – Deliverable DR1.8 & DR1.9. The summary shows a ranking from fruit production regions from south (Lleida) to north (The Netherlands). For each production region the main characteristics (apple acreages, rainfall and severity of scab) and control strategies (monitoring, interval planning, spray frequency) are specified.

The Annex 2 shows increasing scab problems when travelling from south (Lleida; minor scab problems) to north (The Netherlands; severe scab problems). The severity of the problems is related to climatic conditions. In the southern regions (Spain, Rhone Valley, Italy) climate is warmer and dryer, resulting in relatively small scab problems. North of the Alps (Switzerland, Germany, The Netherlands) climate is cooler and more humid, resulting in relatively big scab problems. Parallel to the increasing severity of the scab problems the efforts for scab control are also increasing. In the northern regions growers and advisors pay much more attention to forecasting of infection periods (spray interval planning), pesticide management (efficacy versus and resistance management) and sanitation (urea sprays; mulching; leaf shredding) than in the southern regions. Last but not least the spray frequencies for scab control are much higher in the northern regions (15-25 sprays) than in the southern regions (6-15 sprays).

The patterns described in the previous section again support the hypothesis that fruit growers are balancing expected yield losses against control strategies. In the northern fruit production regions the severity of scab problems is much higher and causes bigger yield loss risks than in the southern regions where apple scab is a minor problem. In the northern regions the risk is further increased by disease resistance against fungicides. As a result growers and advisers in the northern regions spend much more time and effort to forecasting of infection periods, pesticide management, sanitation and pesticide application in order to keep apple scab infestations at acceptable levels.

3.4. Reflection

The two south-north gradient analyses in the previous sections has revealed interesting differences in integrated control strategies for codling moth and apple scab. The gradients presented provide clear support for the hypothesis that growers are balancing the costs of their control strategies against the expected yield and quality losses.

This implies that growers with high risk perceptions for specific pests or diseases are more motivated to spend time and effort in advanced and innovative control strategies than their colleagues with low risk perceptions. In case of low pest/disease pressure there is little need for including advanced and innovative strategies in the control system. This supports the statements of the advisors during the meeting of 5th February 2009 in Wädenswil that growers do not switch to new and expensive techniques as long as the necessity does not exist.

What does this mean for the ENDURE sub activities mentioned in the introduction:

- **RA2.5 System Case Study Orchard**
  Introduction of advanced and innovative control strategies is most promising in fruit production regions where growers perceive the risk of a specific pest or disease as high. Example: codling moth in Spain or Italy; apple scab in Lake Constance or Netherlands.
- **RA3.2 Socio-economic driving forces of crop protection strategies**
  Expected yield losses, costs of current/advanced/innovative strategies and the effectively of current/advanced/innovative strategies to reduce yield losses are crucial for the grower for balancing expected yield risks and costs of control strategies.
  The existence of south-north gradients implies the need of region specific data.
- **RA3.4 Life Cycle Assessment**
  The economic criteria for the life cycle assessment may need some modifications, so that the balancing of expected yield risks and costs of control strategies is sufficiently covered. These will be implemented in development of the assessment tool DEXiOS, during the 4th JPA.
  Restricting data-collection to selected pests/diseases in selected regions?

Restricting to major pests and diseases, when describing cropping systems in regions?

3.5. References

Avilla, Jesus, Bart Heijne and Klaus Paaske (2008) State of art of scab, brown spot and codling moth prevention and control strategies. ENDURE, Deliverable DR1.8 & DR1.9 “Survey and analysis of the state of art of scab, brown spot and codling moth prevention and control strategies”.

Buurma, J.S. (1997) Causes of differences in pesticide use between farms; scab control in apples The Hague, LEI-DLO, Publication 4.143

Heijne, Bart (2009) Minutes of RA2.5 Orchard System Case Study meeting in Wädenswil, 5th February 2009

4. Technical analyses

by Bart Heijne (WUR/PPO) and Jesus Avilla (UdL)

4.1. Introduction

Below is a summary of remarks and suggestions based on the results of the Case Study Pomefruit (RA1.2 Case Study Pomefruit). Due to time restrictions during the meeting and the focus of the RA1.2 Case Study Pomefruit only a few subjects were discussed. They were:

1. the IPM situation of brown spot on pear
2. the use of mating disruption against codling moth
3. the use of granulose virus against codling moth
4. the use of sanitation practices against apple scab.

4.2. A summary of advisors opinions

4.2.1. IPM for brown spot of pear caused by *Stemphylium vesicarium*

Brown spot of pear is important only in Spain, Italy, Belgium and the Netherlands. Therefore only three main opinions were mentioned.

- Biological control is impaired because practitioners are interested in chemically based IPM mainly because it is cheap and effective.
- There is still too little knowledge about the disease. For example in France in 2008 there was heavy rain but no brown spot; why?
- A bio control agent, containing *Trichoderma* is tested mainly at the research level. However, the implementation is close to practice in Spain and Italy where some demonstrations were done in commercial orchards.
- In Italy, the main problem will be the lack of active ingredients, which will force the producers towards IPM. This is further stimulated by the requirements of low amounts and numbers of pesticide residues by super markets and for import in some countries (e.g. Russia). Italian growers who are not forced towards IPM will not practice it; they are happy and comfortable with pesticides because of traditional habits and low costs of pesticides.

4.2.2. Implementation of mating disruption technique to control codling moth

Codling moth is a major pest in Europe and differences in approach exist (previous chapter). Hereafter are given a summing up of opinions for different European regions.

- In the Netherlands, populations and damage of codling moth are relatively low and the damage can be prevented by cheaper and easier to apply other means like insecticides. Therefore mating disruption is not widely used in the Netherlands. The system is not reliable. Very expensive technique to solve the problem.
- In Spain, populations of codling moth increase quickly with three generations per year. In this situation mating disruption is not enough effective and is combined with the use of pesticides. Growers argue that they can use only pesticides to control codling moth and saving costs by omitting mating disruption. Moreover, a lot of orchards are small and consequently mating disruption is not very effective. And also, resistant codling moth populations exist in Spain. Mating disruption is promoted by 50 % subsidising the direct costs and monitoring of the pest.
- On the contrary, in the south of France, mating disruption is used in up to 70 % of all orchards, in spite of the high number of generations. The additional costs on top of control with insecticides are relatively low (about 30 €/ha) of total costs to control codling moth, which are about 220 €/ha. Growers are worried about the emergence of secondary pest if

codling moth control is mainly done by mating disruption all the more so as, because mating disruption tools for other pests are not authorised in France.

- Main reasons for a limited use of mating disruption in Germany are the high costs linked to the use of mating disruption + Virus spray+ insect growth regulator (IGR) and a too low efficacy. Mating disruption is subsidised by the authorities. In the lake Constance area, experiences were made that have led to a 75% decrease in the number of sprays.
- In Switzerland, the IFP tools used to be piled up as in Germany but as soon as the producers were reassured, the switch to mating disruption was acquired and 70 % of the orchards are covered now.
- In South Tyrol (Italy) mating disruption is successfully used.

4.2.3. Use of granulose virus to control codling moth

The use of granulose virus is a very selective and unique integrated control tool for control op codling moth in pomefruit. In summary, the advisors opinion is given hereafter.

- In Spain, temperatures are high during the season and consequently the virus is inactivated quickly, resulting in a low persistence. Only in the beginning of the season when temperatures are still low granulose virus is used.
- Since the population of codling moth is limited in the Netherlands, and granulose virus should be applied frequently, the costs of the product and the labour to apply the virus are relatively high.
- In several regions, resistance of codling moth against granulose virus developed and the virus became less effective. This was technically solved by new strains of the virus. However, in some countries new strains of the granulose virus should be registered as a new product (e.g. in France). This new registration is jeopardised by the high costs associated with this process. This is an important bottleneck.

In general, costs of registration of biological control methods, like pheromones and granulose virus, is a substantial bottleneck for the progress of IPM in fruit growing. Additionally, if registration is obtained at European level, individual countries are free to restrict the use in their country, for example in Italy, there are 3 to 4 more compounds allowed than in France. Countries also ask for demanding registration procedures that discourage companies to submit an authorisation procedure for the IFP tools that they are selling. This results in imbalance between countries and between costs and affects the possibilities to make profit from these products and hence it leads to a restricted market.

4.2.4. Use of sanitation practices to control apple scab

Although apple scab is the major disease of apple in Europe, sanitation methods are not very popular among growers. Sanitation methods are non-chemical culture methods which reduce inoculum source in orchards. This is clearly seen in the opinion of fruit advisors from the different European regions.

- Sometimes sanitation practices interfere with other agronomical practices such as weed management or fertilization.
- Sanitation can be done with application of urea during leaf fall and shredding leaves after leaf fall.
- In France, the use of urea is in conflict with fertilisation regulation and is therefore little used. Urea applied during the leaf fall period reduces the inoculum for next year. The nitrogen, deriving from the urea application during the leaf fall period, might contaminate ground water. On the other hand, leaf shredding is done to a large scale in some areas in the south west of France. But fungicides are still essential in spring. The number of fungicide applications is not reduced under high inoculum pressure. The same is true for the use of decision support systems.

- Fungicides are absolutely necessary to control apple scab in spring in the Netherlands, also when sanitation is done during autumn. Furthermore, sanitation practices are difficult to apply during wet autumn conditions. In average, growers can control scab well with fungicide and don't need to use sanitation practices to reduce the inoculum pressure. This is also the main reason why sanitation practices are not applied in Denmark.
- In Switzerland, there was little motivation for forced sanitation practices, however shredding or mulching of fallen leaves is often done. Fungicides work well and growers do not need a lot of applications.
- A difference in the way of thinking was noted in Germany. Growers applying integrated fruit production still think in chemicals; chemicals are easy to apply and growers are accustomed to them. On the contrary, organic growers think in strategies. They are more motivated to apply sanitation.

4.3. Conclusions

It is concluded, that apart from often mentioned economic and social arguments, reliability and total efficacy are mentioned as weak points for the majority of integrated control tools. With reliability is meant, that the integrated control methods work well or at least at more or less at the same level from year to year. Integrated control methods with varying efficacy between years or seasons are considered unreliable. In general, the efficacy of non-chemical alternative methods is close to, but often not quite as good as chemical control. Often additional labour or other measurements are required in combination with the alternative non-chemical method. So, in summary it is concluded that:

- The reliability of many integrated control tools is too low.
- The efficacy of a substantial part of integrated control tools is just reaching the efficacy level of pesticides.
- The registration procedure length and costs is hindering implementation of new alternative integrated control tools.
- Technical changes are necessary for several integrated control measures in orchard systems to improve their reliability and efficacy.

5. Conclusions

Three different approaches were used to analyse implementation of integrated control tools into practice: social, economic and technical approach. Besides a list of detailed conclusions, as described below, three major conclusions became prominently visible. These major conclusions are based on deliverable DR1.8 & 19 9 “Survey and analysis of the state of art of scab, brown spot and codling moth prevention and control strategies” and from fruit advisors input. These major conclusions are:

7. Reliability
   Growers strongly weigh the reliability of new integrated control tools against that of the use of pesticides. Often, their perception of the reliability, òr the objective reliability on the new integrated control tools is lower than that of pesticides.
8. Efficacy
   Growers are used to the relative high efficacy of pesticides. The majority of the new integrated control tools is less effective, òr has to be repeated more times, òr takes much more labour than the efficacy, frequency or labour efforts of pesticides.
9. Economy
   Very often the new integrated control tools are more expensive than traditional use of pesticides.

It is recommended to focus research on providing solutions to improve reliability, efficacy and economic aspects of the new integrated control tools.

Below is an overall summary of conclusions from the analysis:

- Growers and consequently advisors talk more about solutions or measurements than about strategies.
- Orchards with larger surfaces have to hire extra labour. Organisation of the extra labour does not always match with timing of integrated control tools.
- In smaller orchards, growers often have other jobs and consequently are limited in the amount of time and the timing of activities to be spent on integrated control tools.
- Some drivers for change towards IPM are:
  - use of less labour;
  - training and education level of the staff;
  - adequate assessment tools, to clearly and immediately see the effect of IPM measure in yield or more precise management.

- Marketing “club varieties” is a growing phenomenon in Europe. IFP is not always included in the marketing concepts of these new varieties.
- Supermarkets more and more determine the marked for fruit and they require cheap, unsprayed and nice looking fruits, a contradictio in terminis.

- Growers are balancing the costs of their control strategies against the expected yield and quality losses.
- IPM introduction is most successful if growers perceive a specific pest or disease as threatening their yield.
- Expected yield losses are strong driving factors.

- The reliability of many integrated control tools is too low.
- The efficacy of a substantial part of integrated control tools is just reaching the efficacy level of pesticides.
- The registration procedure length and costs is hindering implementation of new alternative integrated control tools.

- Technical changes are necessary for several integrated control measures in orchard systems to improve their reliability and efficacy.

Appendix 1 Economics of codling moth control; a north-south gradient analysis

ENDURE - RA 2.5 - System Case Study Pomefruit **ANNEX 1**

Economics of pest/disease control in pomefruit; a North-South gradient analysis on basis of Deliverable DR1.8 & DR1.9

Codling moth in apples	Lleida	Rhone V	Emilio R	South Tirol	Trentino	LC - Swiss	LC - German	Netherlands	Sweden
apple acreage (ha)	9300 ha	8000 ha	6000 ha	18000 ha	12500 ha	1600 ha + 140000 trees	7500 ha	9500 ha	1700 ha
codling moth severity	2,5 genera	1,5-2,5 gen	2,5 genera	2,0 genera	2,0 genera	1,0 genera	1,0 genera	1,0 genera	1,0 genera
pheromone traps	common	25% growers	**common**	extension	common	extension	extension	20% growers	5% growers
fruit damage season	**common**	**growers**	**common**	**growers**	**common**				
fruit damage harvest	**common**	**growers**					**growers**	**growers**	
sanitation				fallen fruit damaged fruit		90% growers	high damage		
forecasting	phen.models spatial distib.	phen.model	phen.model bulletins	temp.sum	phen.model	sopra-model	sopra-model	rimprocydia	rimprocydia
mating disruption	100% growers	40% growers	10% surface	75% growers	30% growers	not feasible in meadow trees	15% growers	5% growers	organic
granulovirus	rarely		33% surface	very rarely	rarely			50% growers	
pesticides	alternating	alternating	alternating	incidental	IGR	IGR; common	IGR; priority	alternating	alternating
resistance problems	IGR; mild OP; mild	IGR OP	IGR OP						
concerns				clim.change		second.pests	clim.change second.pests	second.pests	

Appendix 2 Economics of apple scab control; a north-south gradient analysis

ENDURE - RA 2.5 - System Case Study Pomefruit **ANNEX 2**

Economics of pest/disease control in pomefruit; a North-South gradient analysis on basis of Deliverable DR1.8 & DR1.9

Apple scab	Lleida	Rhone V	Emilio R	South Tirol	Trentino	LC - Swiss	LC - German	Netherlands	Sweden
apple acreage (ha)	9400 ha	8000 ha		18000 ha	10000 ha	1600 ha + 140000 trees	8000 ha	9500 ha	
rainfall (mm/year)	400 mm	500-700 mm		750 mm	900 mm	1200 mm	700-1440 mm	800 mm	
scab problems	minor	minor		minor	minor	severe	high severity	high severity	
leaf infection - season		**prod.group**		**extension**	**extension**	growers	10% growers		
fruit damage - season	**advisors**				**extension**				
fruit damage - harvest					**growers**		**growers**	**growers**	
fungicide sprays (#)	6-10 sprays	5-10 sprays		12-15 sprays	15-18 sprays	12 sprays	25 sprays	17-25 sprays	
spray interval planning	Mill's curves	Clean Arbo			RIMpro	Agroscope	RIMpro	RIMpro	
					spore traps	spore traps	spore traps		
	weather cond.	weather stat.		rain periods	weather stat.	weather stat.	weather stat.	weather stat.	
				leaf growth			leaf growth		
communication	email + sms			phone + sms	phone+email	fax + phone	fax + phone	email + sms	
resistance problems	unknown	minor		no	no	low	high	major	
pesticide strategy	**prot/curative**	**prev/curative**			**preventive**	**prot/curative**	**protective**	**preventive**	
		activity				effectiveness	effectivity	efficacy	
	mode of action	mode of action		mode of action	mode of action	mode of action	mode of action	environment	
sanitation	urea (20-40%)	urea (70%)		urea	urea	urea	urea	urea	
	leaf shredding	leaf shr (50%)		mulching	mulching	mulching	mulching	leaf shredding	
							"Elise"		
resistant cultivars	not relevant	about 1%		Topaz (1%)	not relevant	Topaz (3-4%)	Topaz (3-4%)	about 1%	

Appendix 3 Questionnaire sent to the advisors prior to the meeting

Advisors' profile
IFP stands for Integrated Fruit Production

1

Organisation of origin:
Nature of the organisation (public/private/ Professional, other?)
Does your organisation have partnerships with other companies?
If Yes, which ones?

2

Name:
Age:
Email:
For how long have you been involved in advisory services?
Which region?

Number of producers supervised?

3

Which type of producers (monoculture?, important (define important) producers ? Small ones?) Please detail.

For how long have you been supervising the same producers?

What is the importance of IFP among them? Have they all adopted IFP? Please detail

Do they have the same understanding of what IFP is ? Please detail.

4.

Are there specific steps through which a producer has to go for implementing IFP? If yes what are the major ones?

Is that a gradual process or a complete change for producers?

How would you describe your work for implementing IFP?

Approximately, how long do you spend meeting with producers to talk about IFP (in days/week or week/year)?
How is the quality of your advisory work assessed? What are the important variables?

Do you participate in IFP training programs for yourself? Please detail.

Do you organize IFP training programs for the producers? Please detail

5.

What is your definition of a well kept orchard? Please describe.

How would you assess the achievements of the producers in implementing IFP?

Appendix 4 Power point slides used for the discussion

Title: Discussion of social bottlenecks with advisors.
Wädenswil. Feb the 5th 2009

Slide 1: Objectives

Discussion on the social bottlenecks that prevent producers from adopting Integrated Fruit Production (IFP)
Basis : Interviews with researchers 2008
Method: group work

Slide 2: Work organisation

"It is difficult to adopt the best spraying agenda because I have other tasks to do or I must leave for the week end".
Can you comment on the difficulties linked to work organisation?
Margins of progress?

Slide 3: Collective organisation

«The Producers Organisation pays the wages of the guy who goes into the orchard to monitor the pest pressure»
Can you discuss the pros and limits of collective organisation in your area?
Do collective organisations participate in implementing a learning process?

Slide 4: Market

«Topaz has potential for farmers doing direct commercialization »
Marketing clubs such as those created for Ariane in France could be a solution for promoting resistant cultivars. Do these clubs exist in your country?
Do retailers in your area have specific IFP demands?
Do you ever consider advising producers to work with local consumer groups or NGOs ?
What do you think consumers expect in terms of product and conditions of production?

Slide 5: Producers

" I was always interested in techniques"
What are the non economic drivers to IFP for producers?
What are the steps that lead to implementing IFP?
Do you have contacts with advisors specialised in organic production?
Difficulties linked to the implementation of ad hoc training?

Appendix 5 List of participants to the RA2.5 Orchard System Case Study meeting at Wädenswil, Switzerland on 5th February 2009.

Name	Family name	coun-try	Institution	Extension Service	E-mail
Alda	Butturini	IT	Plant Protection Service – Emilia Romagna Region	yes	abutturini@regione.emilia-romagna.it
Andrea	Patocchi	CH	ACW		andrea.patocchi@acw.admin.ch
Andreas	Naef	CH	ACW		andreas.naef@acw.admin.ch
Aude	Alaphilippe	F	INRA		aude.alaphilippe@avignon.inra.fr
Bart	Heijne	NL	WUR		bart.heijne@wur.nl
Benoît	Sauphanor	F	INRA		benoit.sauphanor@avignon.inra.fr
Bernard	Blum	CH	IBMA		bjblum.ibma@bluewin.ch
Burkhard	Golla	D	JKI		burkhard.golla@jki.bund.de
Carlos	Lozano	SP	Plant Protection Service, Government of Aragon	yes	cmlozano@aragon.es
Henny	Balkhoven	NL	Fruitconsult	yes	henny@fruitconsult.com
Isabelle	Haynes	F	INRA		isabelle.scherer-haynes@grignon.inra.fr
Jan	Buurma	NL	WUR		jan.buurma@wur.nl
Jesús	Avilla	SP	UdL, University of Lleida		jesus.avilla@irta.cat
Joan	Solé	SP	UdL, University of Lleida		joan.sole@irta.cat
Jörg	Samietz	CH	ACW		joerg.samietz@acw.admin.ch
José	Hernández	CH	ART		jose.hernandez@art.admin.ch
Julien	Blanc	F	MNHN / Aarhus University		jblanc@mnhn.fr
Klaus	Paaske	DK	Aarhus University		klaus.paaske@agrsci.dk
Martin	Trautmann	D	KOB- Bavendorf	yes	trautmann@kob-bavendorf.de
Pascal	Borioli	F	GRCETA	yes	pascal.borioli@grceta.fr
Patrik	Mouron	CH	ART		patrik.mouron@art.admin.ch
Peter	Triloff	D	MABO	yes	peter.triloff@lindavino.de
Pieter	Aalbers	NL	DLV Plant	yes	p.aalbers@dlvplant.nl
Riccardo	Bugiani	IT	Plant Protection Service – Emilia Romagna Region	yes	rbugiani@regione.emilia-romagna.it
Richard	Hollenstein	CH	Plant protection service SG	yes	richard.hollenstein@lzsg.ch
Robert	Wiedmer	IT	Extension Service South Tyrol	yes	robert.wiedmer@beratungsring.org
Sylvaine	Simon	F	INRA		sylvaine.simon@avignon.inra.fr
Vittorio	Veronelli	IT	CBC		vveronelli@cbceurope.it
Urs	Müller	CH	Plant protection service TG	yes	urs.mueller@tg.ch