

# Occupational exposure to pesticides

## Challenges for research, evaluation and prevention

Conference

28&29

OCTOBER 2014

Auditorium - siège de l'Anses  
27/31 avenue du général Leclerc  
94701 Maisons-Alfort cedex - FRANCE



# Occupational exposure to pesticides in agriculture. An on-going expertise at Anses.

**Presented by C. Laurent for the working group  
« exposure of farm labour to pesticides »**

Experts of the working group (February 2012- February 2015):  
LAURENT Catherine (Chair), BALDI Isabelle (Vice Chair),  
BERNADAC Gérard, BERTHET Aurélie, COLOSIO Claudio,  
GARRIGOU Alain, GRIMBUHLER Sonia, GUICHARD Laurence,  
JAS Nathalie, JOUZEL Jean-Noël, LEBAILLY Pierre,  
MILHAUD Guy, SAMUEL Onil, SPINOSI Johan, WAVRESKI Pierre

## Context of the work

---

- **High consumption of pesticides** in the French agriculture (e.g. crop protection expenditure / total output / farm)
- **European regulation on pesticide use** (2009)
- **Over a million people** are potentially exposed to pesticides during farm activity + retired farmers and farm workers who were exposed
- **A number of epidemiological studies provide evidence** of a relation between exposure to pesticides and certain chronic diseases (Inserm 2013)
- **Concerns and alerts** from various types of stakeholders and from national representatives from all political groups (Bonnefoy 2012, Gatignol, Etienne 2010, etc.)
- **Lack of identified knowledge on exposures to pesticides in real conditions.**

## « Farm labour » in France

	Person	Agricultural Working Units
Head of the farm	514 742	369 095
Farm family labour (spouses...) with a regular activity of the farm (including salaried workers)	335 145	187 349
Salaried workers. Regular activity on the farm. Not member of the family	162 929	135 362
Salaried workers with non regular activity	???	87 210
Labour working on the farm but not employed by the farm	???	12 170
	1 012 816 + ???	791 186

- + family living on the farm
- + retired farmers not living on the farm but still having some activity
- + retired people (farmers, farm workers...) who had on-farm activities

# Mission of the expert group (Feb.2012-Feb 2015)

---

1. **To better describe the farm labour population that is potentially exposed** to “pesticides” according to different production systems and supply chains (which types of workers are they more exposed? For which type of production system? etc.). **“Pesticides” = crop protection products + biocides + some veterinary drugs.**
2. **To identify the main factors responsible** for occupational exposures to pesticides in the French agriculture
3. **To inventory and analyse available knowledge** regarding the levels of occupational exposures to pesticides in the French agriculture
4. To link the information on the levels of exposure with sanitary data

→ In order to better inform interventions that would aim at reducing these exposures

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
**AND France**

Exposures AND Farm labour AND  
Pesticides **(all countries)**  
Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND **France**)

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
**AND France**

Exposures AND Farm labour AND  
Pesticides **(all countries)**  
Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND **France**)

## 3) Analysis of the possibilities open by other sources of information

**Statistical data** (farm census,  
Rica, national survey on farm  
practices)...

**Various warning systems**  
(phyt'attitude, RNV3P...)  
**Direct field investigations**

**Data used for  
the registration  
of the products**

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

Sharing expertise from various disciplinary stand points. Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
**AND France**

Exposures AND Farm labour AND  
Pesticides **(all countries)**

Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND **France**)

## 3) Analysis of the possibilities open by other sources of information

**Statistical data** (farm census,  
Rica, national survey on farm  
practices)...

**Various warning systems**  
(phyt'attitude, RNV3P...)  
**Direct field investigations**

**Data used for  
the registration  
of the products**

## A multidisciplinary expertise

---

There are **critical differences between assessing hazard and exposure** (OECD 1997, 2003, 2006)

- Hazard is largely inherent to a chemical and does not fundamentally change over space and time, whereas **conditions that determine exposure differ enormously according to a large set of factors**: working conditions, regulations, production systems, available information on toxicity and risk perception, economic constraints....
- **For agriculture the situation is very complex**: heterogeneity of the practices in millions of small scale enterprises, changes of the products over the years, concomitant use of several products for one treatment, and addition of treatments for the various productions of the farm, lack of record keeping...
- The working group brings to bear **a wide range of disciplinary expertise**: agronomy, biometrology, economics, epidemiology, ergonomics, ergotoxicology, expology, history of science, metrology, occupational medicine, sociology, statistics, toxicology, veterinary sciences.

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
AND France

Exposures AND Farm labour AND  
Pesticides **(all countries)**

Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND France)

## 3) Analysis of the possibilities open by other sources of information

**Statistical data** (farm census,  
Rica, national survey on farm  
practices)...

**Various warning systems**  
(phyt'attitude, RNV3P...)  
**Direct field investigations**

**Data used for  
the registration  
of the products**

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
**AND France**

Exposures AND Farm labour AND  
Pesticides **(all countries)**

Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND **France**)

## 3) Analysis of the possibilities open by other sources of information

**Statistical data** (farm census,  
Rica, national survey on farm  
practices)...

**Various warning systems**  
(phyt'attitude, RNV3P...)  
**Direct field investigations**

**Data used for  
the registration  
of the products**

# Systematic review of the scientific literature Exposures of farm labour in France

---

## Objectives

Inventory of available literature with transparent and explicit procedures

- in order to identify existing data and analyses on occupational exposure to pesticides in the French agriculture
- and in order to produce a database which could be up-dated by the Anses and could be shared by different types of stakeholders and the public

- **Methodology of systematic review** (Cochrane Collaboration and Campbell collaboration)
- **Results were published in February 2014 with a call for complementary contributions**

## Data bases

Scopus, Pubmed, Science Direct, Ovid (medline +géobase, Georef, PsyCritiques), Econlit, Cairn et l'ensemble (Socindex, International Political Science abstracts, Political Science, Historical abstracts) Cochrane

**Farm Labour AND Exposures AND Pesticides AND France**

**1194 results**

(with )

Checking inclusion criteria.  
Reading abstracts +/- papers

Assessment of the quality of the  
papers. Template per discipline

**101 papers selected**

**18 papers  
rejected**  
do not meet inclusion  
criteria

**69 relevant  
papers**

**14 publis hors  
critères**  
do not meet inclusion  
criteria but relevant for  
the context analysis

# Key points in the literature (France) concerning Measurements in environment and humans

---

- 13 articles potentially documenting pesticide exposure in agricultural workers :

2 *a posteriori* excluded ( not relevant)

3 without original data (review, synthesis, use of models,...)

## 8 providing original data

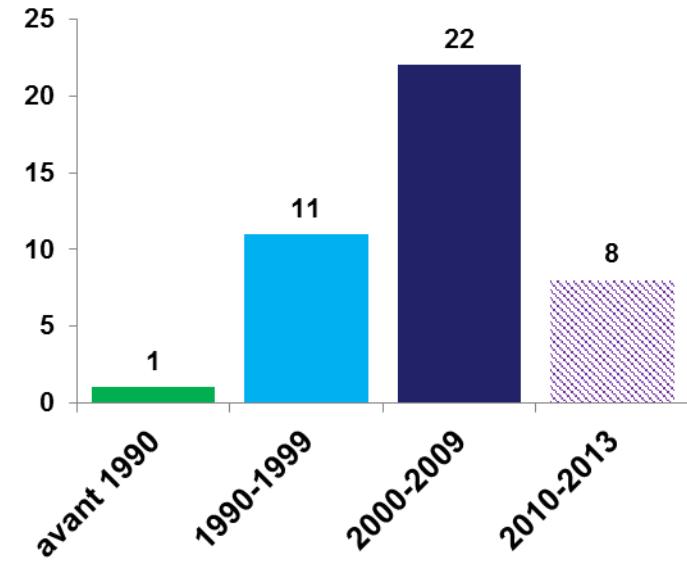
- 3 from PESTEXPO study: external contamination (dermal and respiratory), determinants of exposure in vineyard and field cropping : no biometrology
- 3 others : pesticide application in greenhouses, vineyards, walnuts – no biometrology
- 2 from MSA: urinary metabolites (dithiocarbamates and Arseniates) combined with observations on equipment and practices

- Not many studies and quite recent (all >2000 but 1 in 1985)
- Rather limited field observations with heterogeneity in protocols and parameters collected in the field
- Main determinants considered:

Tasks, number of working phases, type of spraying equipment (with or without cabs), technical hitches, level of education, working status

# Key points in the literature (France) concerning epidemiological approach (1/2)

- An increasing number of epidemiological publications on health effects associated to agricultural pesticide exposures in France N=42
- 21 on cancer  
15 on neurological outcomes  
5 on reproduction/development  
1 on anemia



- 11 were actually designed to assess the impact of agricultural pesticides on the general population (4 on reproduction, 6 on cancer, 1 on anemia)
  - *Exposure = Environmental indicators (based on farm census)*
  - *No detail on agricultural activities generating exposures*

## Key points in the literature (France) concerning epidemiological approach (2/2)

---

- In the remaining 31 publications, most of the time, data were collected from people working in the farms (questionnaires, sometimes completed or combined with expertise)
- Most of the time, limited and rough data:
  - Occupational history
  - **+/- data on tasks**, spraying equipment, protective equipment, **rarely taken into account in the analyses**
  - **Crops** not always mentioned
  - **Specific pesticides** rarely documented
- Exposure studies limited to **pesticide application** on crops
- Difficulties of retrospective **collection of data** (based on memory). No archived data

# Key points in Ergonomics Literature Survey concerning France

---

11 papers selected, 2 papers identified by Scopus, Pubmed and ScienceDirect. Most of the papers not found with Scopus, Pumed or Sciencedirect. Papers identified by the experts have been added

- Underestimation of the ergonomics publications identified from the data base
- Few papers concerning agriculture, health and working conditions in agriculture in ergonomics publications, specially in France (2 papers dealing with viticulture, 1 with viticulture /greenhouses, 2 with PPE, 1 about the use of on fungicide);
- Some papers discuss the interest to take into account:
  - cultural aspects in the elaboration of risk representations;
  - the integration of activity analysis and measurement of physical constraints and pesticides exposure;
  - diachronic approaches;
  - co-design of the technical systems and training, involving the participation of the workers as final users

# Key points of the literature review on France

## – Social sciences and humanities –

---

11 papers ( 8 results on Cairn and 4 international databases specialized in SSH; 3 additional from own documentary database.

- **Very little information** on exposures themselves that could be used.
- Evidence of a huge **gap between the prescriptions and the reality of the agricultural work.**
- Reduction of the level of pesticide is envisaged only to improve income, or to decrease the level of residues in food products or in the environment. **Occupational health is never mentioned.**
- The **lack of knowledge on occupational exposures is also a social construction**: eg. Statistical invisibility of the effects of health resulting from a lack of declaration of the victims of poisoning who feel that they are responsible for this poisoning

# Key points of the literature review on France

## – economics –

---

Only 4 extra documents meeting the inclusion criteria were identified. Providing little extra information

The specificities of the French situation can be characterized by the blind spots of the economic literature on France, compared to foreign situations

- The total **lack of concerns regarding occupational health** in the research area « agriculture / pesticides ». Hundred of papers on environmental issues.
- **No study on the impact of the perception of occupational risks associated to pesticide use on economic behaviours:** technological choices, micro-economic decisions at farm levels, final consumers' behaviours, marketing strategies of alternative supply chains....
- **No scientific paper** in health economics reporting research **on the cost of negative health impact** of pesticide use (accidents, chronic diseases)
- **No scientific paper** reporting assessment of the **effectiveness of interventions aiming at the reduction of risks associated to pesticide use in agriculture** (occupational health concerns of advisory services, specific interventions...)

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
**AND France**

Exposures AND Farm labour AND  
Pesticides **(all countries)**

Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND **France**)

## 3) Analysis of the possibilities open by other sources of information

**Statistical data** (farm census,  
Rica, national survey on farm  
practices)...

**Various warning systems**  
(phyt'attitude, RNV3P...)  
**Direct field investigations**

**Data used for**  
**the registration**  
**of the products**

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
**AND France**

Exposures AND Farm labour AND  
Pesticides **(all countries)**

Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND **France**)

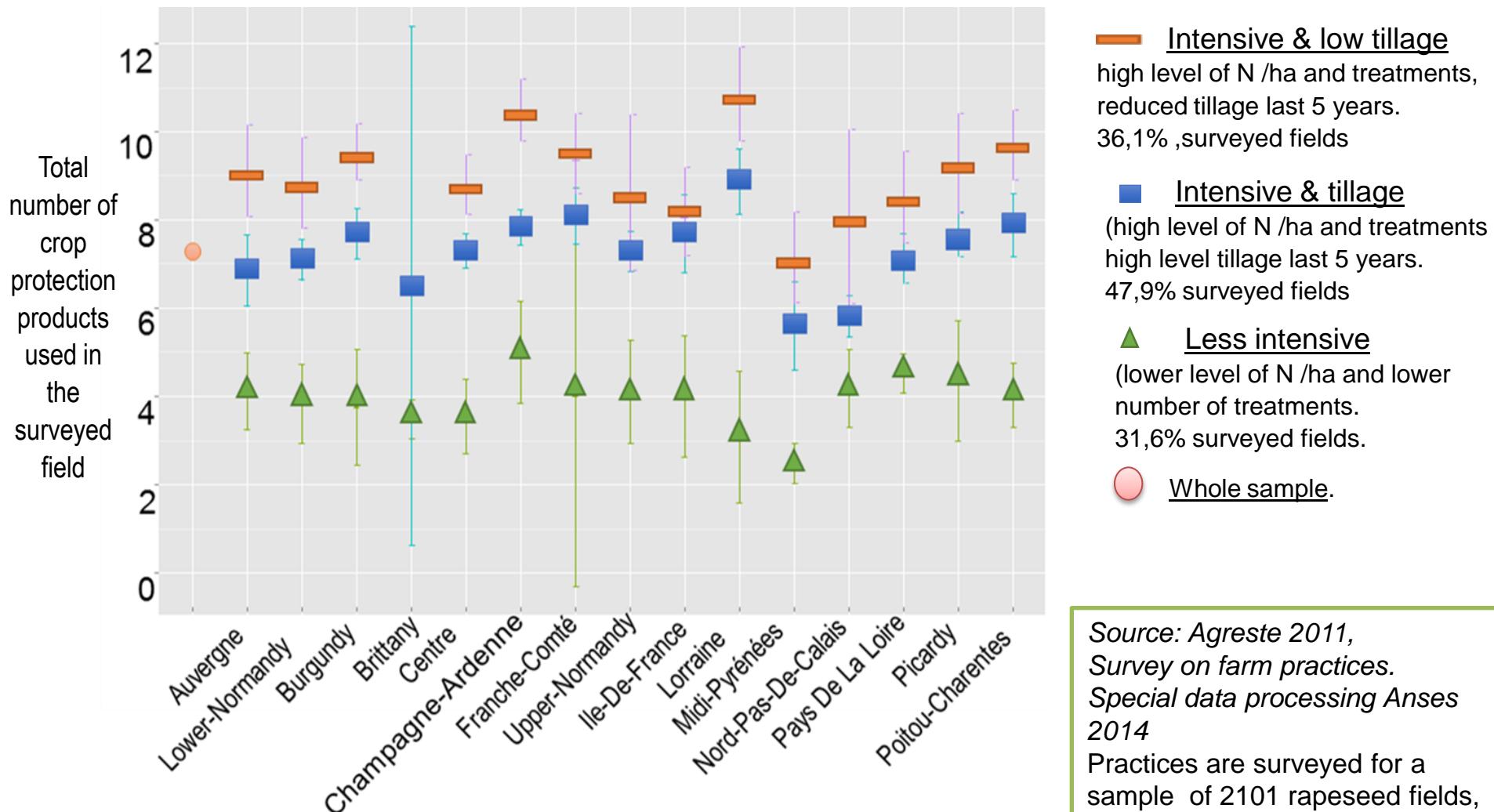
## 3) Analysis of the possibilities open by other sources of information

Statistical data (farm census,  
Rica, national survey on farm  
practices)...

**Various warning systems**  
(phyt'attitude, RNV3P...)  
**Direct field investigations**

**Data used for  
the registration  
of the products**

## Combined exposures: number of products for one crop (rapeseed) in one field during for one campaign



# Statistical data. To better assess the context of exposures 2/2

## Combined exposures beyond treatments for one production:

besides combined treatments for each field in one production, each farm has several productions and this should be considered into exposure scenarios.

Index of the the number of productions that are combined (crops and livestock activities )

Economic size (Standard product, euros)	All the farms		Farms with rapeseed		Farms with sheep		Farms with fruits and permanent crops		
	nb of productions (73 aggregates) median	nb farms							
Small	[0-8000[	2	114 767	2	1083	3	19 329	2	10 720
	[8000-25000[	4	80 404	4	2642	6	9 410	3	10 900
Medium	[25000-100000[	6	156 613	6	19 876	8	18 149	4	15 452
Large	[100000-250000 [	8	114 349	8	33 767	10	7 906	5	8 990
	>ou = 250000	6	48 609	10	15 517	11	1 826	4	4 222
	All farms	5	514 742	7	72 885	6	56 620	3	50 284

(Source Farm Census 2010, special processing ). (Aggregation into 73 groups of productions (e.g. all types of vegetable are aggregated); diversification activities are not included) (e.g. wood processing, food processing...).

# Three complementary sets of analyses

## 1) Analysis of the context and the issues raised by the mission of the WG

**Sharing expertise from various disciplinary stand points.** Hearings (various representatives from professional organisations, industry, Ministries, NGOs, consultants...). Interactions with Anses staff members (different departments...). Analysis of the regulatory frameworks related to pesticides, identification of possible source of information on exposures (registration procedures...)...

## 2) Reviews of the scientific literature and call for contributions

Exposures  
AND Farm labour  
AND Pesticides  
**AND France**

Exposures AND Farm labour AND  
Pesticides **(all countries)**

Tests with 2 case studies (external insecticides in  
sheep farming, reentry in orchards)

Complementary analysis of **grey literature** (Exposure AND farm  
labour AND pesticides AND **France**)

## 3) Analysis of the possibilities open by other sources of information

**Statistical data** (farm census,  
Rica, national survey on farm  
practices)...

**Various warning systems**  
(phyt'attitude, RNV3P...)

**Direct field investigations**

**Data used for  
the registration  
of the products**

## Combined exposures, beyond crop protection products

Farm labour in sheep farms may be exposed to

1. Veterinary medicines for dips, showers... : external insecticides / acaricides (dips), pour-on... (e.g. with diazinon, deltamethrine, phoxim)
2. Veterinary medicines, biocides, for foot baths (e.g. with formaldehyd)
3. Feed preservatives
4. Crop protection products, for various crops (forage and other crops)
5. Biocides for treatment of farm livestock facilities
6. Biocides for cleaning transport facilities
7. Chemicals used for diversification activities (wool processing, biocides for cleaning food processing facilities...)
8. Others (e.g. doing treatment for neighbours)....

## Overall conclusions

- Very **few data** on levels of exposures and **heterogeneity in protocols** and parameters for field data collection. No organization in charge of data collection.
- Invisibility of most of the production sectors** (livestock keeping, orchards and other permanent crops, horticulture... ). Same statement for some tasks (e.g. treatment of livestock facilities, use of biocides).
- **Invisibility is also a result of a social construction** (e.g. statistical invisibility of health effects). In France for most research on agriculture, occupational health is a non-issue. Resulting feeling of “security”.
- Lack of research on effectiveness of advisory services** (e.g. certiphyto).
- **Literature reviews on foreign situations** (completed for two case studies [reentry – orchard, external insecticide treatment – sheep] allows to put literature on France in a broader perspective and brings information. **Extrapolation possibilities should be assessed carefully.**

# Overall conclusions

## Complexity of the regulation and technical prescriptions

Regulation governing the use of pesticides is extremely complex (PPE, crop protection products, biocides, veterinary medicines...), and difficult to summarize even for specialized experts. Safety recommendation are not designed to integrate the complexity of the farm situation and are not harmonized.

## No provision of integrated advice on chemical risk at farm level.

Lack of competence for part of the suppliers. Compartmentalisation between advice on production and advice on occupational safety (e.g. PPE costs are not included in economic simulations informing technical choices). Prevention messages through internet (e.g. safety data sheets) while less than 50% of the farmers declared to use internet for their farm (RA 2000).

**The responsibility** for gathering and summarizing complex information from various sources, for finding “appropriate” PPE, etc. **is actually transferred to the final users** who are supposed to have “the correct behavior”. Finally, they are the only persons who can be easily identified as responsible of a failure of the prevention framework.

# Merci de votre attention

Occupational exposure to pesticides  
Challenges for research, evaluation and prevention

28&29 OCTOBER 2014

Many **prevention messages are delivered through internet**, important information such as safety data sheets is available only through internet but.... less than 50% of the farmers declared to use internet for their farm

Numbers of farmers using Internet (Farm Census 2010, special data processing 2014)

Economic size (Standard product, euros)		All farms		Type of farming 1600 (general field cropping)		Type of farming 4813 (sheep & goats)		Type of farming 3900 (fruits and permanent crops)	
		using internet		using internet		using internet		using internet	
		%	nbr	%	nbr	%	nbr	%	nbr
Small	[0-8000[	14	16 317	14	2 394	14	4 275	15	1 111
	[8000-25000[	27	21 548	11	749	11	5 190	23	1 031
Medium	[25000-100000[	47	73 553	43	3 682	43	8 042	36	1 961
Large	[100000-250000[	72	82 767	80	6 819	80	2 813	61	1 805
	>ou = 250000	84	40 704	91	4 252	91	697	81	1 259
	All farms	46	234889	39	17896	39	21017	33	7167