Occupational exposure to pesticides
Challenges for research, evaluation and prevention
MATPHYTO program: French crop exposure matrices for retrospective pesticides exposure assessment
More than 1000 active substances have been used in agriculture for pest management as insecticides, fungicides or herbicides.

Cumulative number of active substances of plant protection products approved in France between 1961 and 2014 (according to “index Acta”)

[Diagram showing a steady increase in the cumulative number of active substances from 1961 to 2014.]
More than 1000 active substances have been used in agriculture for pest management as insecticides, fungicides or herbicides.

Acute effects are well-known but there is a lack of information concerning the delayed effects.

Pesticides could be related to the development of serious diseases:
- Cancer
- Neurodegenerative diseases
- Endocrine disruption

But these diseases are multifactorial and could appear several years after exposure.

⇒ Knowledge of past occupational exposures to pesticides is therefore required.
Little information concerning the use of pesticides in France is available.

There is no unique, exhaustive and retrospective database concerning the pesticides used by the agricultural workers.

With this concern, the Department of Occupational Health of the French Institute for Public Health Surveillance has implemented the Matphyto program in association with the University of Lyon 1.

This program consists in developing national crop exposure matrices for plant protection products.
Why using crop exposure matrices?

Job exposure matrices are a well-known tool in epidemiology of occupational risks.

Crop exposure matrices are databases used to assess pesticides exposures for different:

- Crops,
- Periods,
- Geographical areas
Why using crop exposure matrices?

Job exposure matrices are a well-known tool in epidemiology of occupational risks.

Crop exposure matrices are databases used to assess pesticides exposures for different crops, periods and geographical areas.

Crops are a good discriminative variable to describe the use of pesticides.

These matrices can assess occupational exposure of people included in epidemiological studies or in monitoring programs (for health surveillance or prevention).

They allow describing the trends in exposure in defined populations for one-time exposures or for cumulative exposures.
Method

Crop exposure matrices are constructed with an input by crop or by group of crops.

The main French crops are considered.

Databases define the use of pesticides since the 1960’s and for different locations.

These matrices describe the use of pesticides by listing:
- **the types of pesticides**: Herbicides, Insecticides, Fungicides...
- **the chemical groups**: Phenoxyacetic herbicides, organophosphates...
- **specific active substances**: Lindane, dicofol...

For each pesticide, indicators of use are assigned according to the **periods** and the **geographical areas**:
1. **the PROBABILITY**: proportion of farms using an active substance during a year
2. **the FREQUENCY**: average number of annual applications for a given substance
3. **the INTENSITY**: average dose used for one application
## Structure of Crop Exposure Matrices

<table>
<thead>
<tr>
<th>Active Substance A</th>
<th>Active Substance B</th>
<th>...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area A</td>
<td>Period 1</td>
<td>P, F, I</td>
</tr>
<tr>
<td>Area A</td>
<td>Period 2</td>
<td>P, F, I</td>
</tr>
<tr>
<td></td>
<td></td>
<td>...</td>
</tr>
<tr>
<td>Wine-growing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area A</td>
<td>Period 1</td>
<td>P, F, I</td>
</tr>
<tr>
<td>Area A</td>
<td>Period 2</td>
<td>P, F, I</td>
</tr>
<tr>
<td></td>
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<td>...</td>
</tr>
</tbody>
</table>

P=Probability, F=Frequency, I=Intensity
Major stages of the project

**Historical data research**

Bibliographical review (Agricultural statistics, agricultural magazines, index of plant protection products…), crop experts interview…

**Data compilation by agronomists**

Geographical and chronological division, Assignment of indicators of use: **probability, frequency** and **intensity**

**Data validation by experts**

Support of agricultural experts: technical institutes, chambers of agriculture, other organisations…
Crop Exposure Matrices applications

Prevalence to occupational pesticides exposures:

First crop exposure matrices are combined with population data as agricultural census (1970, 1979, 1988, 2000 and 2010) to assess the prevalence of pesticides exposures for agricultural workers by sex, age, occupational period, region, etc.

Work is in progress and complete results are anticipated in the first half of 2015
Crop Exposure Matrices applications

Prevalence to occupational pesticides exposures:

Epidemiological studies and cohorts:

Help to identify the occupational exposures in the study population
COSET cohort, key results and principal findings published in early 2015
Crop Exposure Matrices applications

Prevalence to occupational pesticides exposures:

Epidemiological studies and cohorts:

Occupational medicine: 

Health surveillance of agricultural workers and support for recognition as occupational disease
Crop Exposure Matrices applications

Prevalence to occupational pesticides exposures:

Epidemiological studies and cohorts:

Occupational medicine:

Environmental pesticides exposures:
  Match the crop exposure matrices with crop location data by using a GIS would be a first step to assess environmental exposures
Conclusion

**Matphyto is a national program** that covers most of the crops in France (straw cereals, potatoes, corn, wine-growing...) including French overseas departments (bananas, sugar cane...)

**The data will be widely available** (Internet) to assist in the assessment of occupational exposure to pesticides in the French agricultural context.

These retrospective **exposures are estimated from the knowledge of crops** that are more available data: agricultural census, individual surveys...

**These matrices are scalable**: they will be updated and future improvements could be provided.

Occupational exposure to **all pesticides for all workers** are being explored.
Matphyto is a method for retrospective assessment of occupational exposure to pesticides applicable to population data and available for national surveillance in France

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Action pilotée par le ministère chargé de l’agriculture, avec l’appui financier de l’Office national de l’eau et des milieux aquatiques, par les crédits issus de la redevance pour pollutions diffuses attribués au financement du plan Ecophyto 2018

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