

A SUPPORT DECISION SYSTEM FOR PESTICIDES MONITORING IN THE ATMOSPHERE

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Abstract

The aim of the present study was to develop a decision aid method to evaluate which pesticides should be monitored in priority in the atmosphere. The whole work has been overseen by a steering committee.

A multicriteria method was chosen as no mechanistic models were found to be suitable to establish the required list of pesticides. The steering committee decided on 4 criteria, relevant to both exposure and effects: Persistence, sources to the atmosphere, quantities used in the area and toxicity to human.

A computer tool was designed and completed with a database containing information on nearly 400 used substances and eleven "virtual substances". These allowed comparing lists obtained at national and regional levels.

The method has been applied to different areas in France. Preliminary results showed good agreement between the "priority substances" of the method and those that are monitored in atmosphere. The method and the results are presented and discussed.

Keywords : Pesticides, monitoring, atmosphere, aid decision tool.

Introduction

Air pollution due to pesticides is a recurrent problem related to modern agriculture. Pesticides contaminate the atmosphere through various pathways (direct emissions, volatilisation from crops and/or soil). In France, local associations monitor air quality through series of field measurements. With several hundreds of pesticides sold, the exhaustive monitoring of all substances is impossible due to economic and material constraints. In this situation, choices have to be made to select the most relevant substances for air quality monitoring.

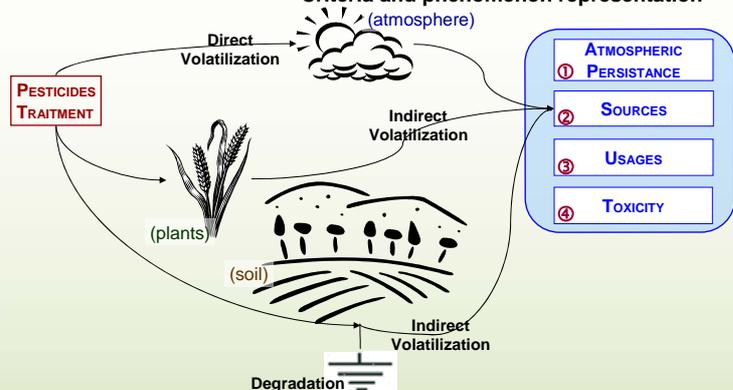
These choices must take into account the inherent toxicity, the persistence in atmosphere and the current levels of all pesticides used. All these criteria have been included in an aid decision method aimed to establish priority lists of pesticides to be monitored in the atmosphere. A computer tool, Sph'air, has then been constructed.

Materials & Methods

The development of the method has been overseen by a steering committee including experts from research and technical institutes, industry, political institutions and air monitoring associations. As mechanistic models are not sufficient to establish the required list of pesticides, experts have agreed on the development of a multicriteria method. Four criteria, relevant to both exposure and effects, have been chosen:

- ① : Atmospheric persistence (half-life data);
- ② : Sources to the atmosphere (unintentional losses during and after application);
- ③ : Current levels of usage;
- ④ : Human toxicity (Acceptable Daily Intake).

Criteria and phenomenon representation



The computer tool Sph'Air consisted in the combinaison of:

- ⇒ One Excel Macro;
- ⇒ The aid decision tool ELECTRE III¹;
- ⇒ A database of nearly 400 substances.

In complement, the concept of virtual substances has been defined to compare lists obtained at national and regional levels.

This method has been applied in different areas in France. Here, the list established for the "Centre" region is given as an example.

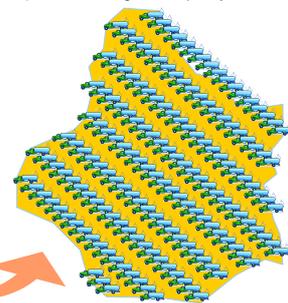
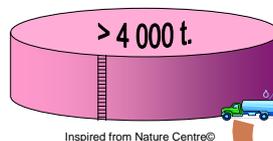
	(10 ³ ha)	(%)
Tillable agricultural surface	2 417	61
Non-tillable agricultural surface	162	4
Poplar plantations and forest	939	24
Non-agricultural surface	435	11
Total surface	3954	100

Data : 2003

From : AGRESTE <http://www.agreste.agriculture.gouv.fr/>

Information about the region's pesticide usage was supplied by Lig'Air (the Centre region air quality monitoring association). It was estimated that in 2001:

- ★ more than 300 active substances were used;
- ★ more than 4 000 tonnes of pesticide were spread.



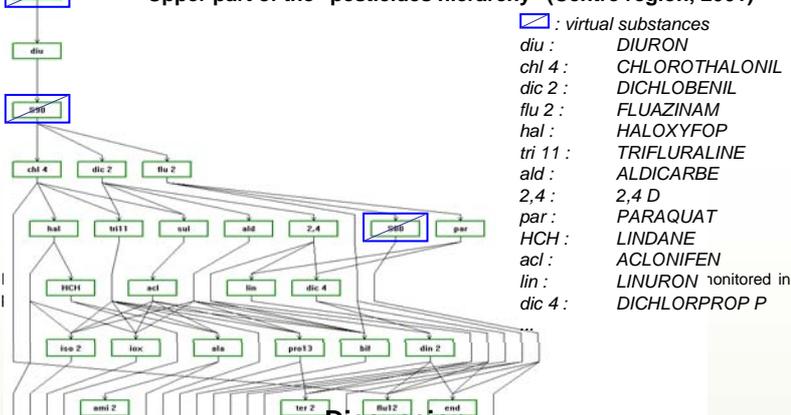
Results

In the "pesticides hierarchy" below, the upper boxes represent the substances that should be monitored in priority in the atmosphere.

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Upper part of the "pesticides hierarchy" (Centre region, 2001)



Discussion

More than 300 substances have been classified quickly and reliably in one hierarchy.

The hierarchy was compared to monitoring data. Most of Sph'Air priority substances have been found in the Centre region atmosphere.

The method has also been applied to the Languedoc region and to the whole France.

Conclusions

- ★ Sph'air is a multicriteria aid decision tool able to rank pesticides according to their expected presence in atmosphere, their toxicity to human, their persistence and the quantity used;
- ★ Sph'air is useful when several hundreds of pesticides are to be classified;
- ★ Sph'air proposes priority lists at different scales, regional or national;
- ★ Sph'air, through the virtual substances concept, allows some comparisons between regions;
- ★ Sph'air is an adaptable method as criteria are easily modified.

- ★ In future, Sph'air may be used to adapt monitoring to new agricultural practices;
- ★ The virtual substances can be used as indicators of any change in usage (new substances, change in quantities applied...).

¹ The software ELECTRE III establishes hierarchical listings of "actions" (here these are pesticides). These actions are characterised by criteria whose values are compared. Electre III has been developed by the Laboratoire d'Analyse et Modélisation de Systèmes pour l'Aide à la décision, Université Paris-Dauphine. Ref: ROY B., 1978. ELECTRE III : Un algorithme de classements fondé sur une représentation floue des préférences en présence de critères multiples. Cahiers du Centre d'Etudes de Recherche Opérationnelle (Belgique), 20, 3-24.