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PEST RISK PERCEPTION ASSESSMENT OF VINEYARD WORKERS

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Introduction

Exposure of farmers to pesticides is often based on assessment of practical factors like pesticides formulation, numbers of treatments, type of sprayers, crop surface, efficiency of personal protective equipments or compliance with security practices (Zainal and Que Hee 2003; Vitali, Protano et al. 2009). Few studies in literature focus on health risk assessment of those factors (Gammon, Liu et al. 2012) and the risk assessment included in the marketing authorization files are not easily accessible.

Also, pest risk perception plays an important role on compliance with safety practices, decision making processes such as choice of products formulation, crop management and compliance with the use of PPE (URCAM and DRASS 2003). The links between risk perception, exposure to pesticides, decision making process and their impact on health consequences remains poorly studied.

Objectives

This work aims to assess the pest risk perception by vineyards growers. This allows determining the impact of risk perception on the vineyards growers' exposure and the associated health risk.

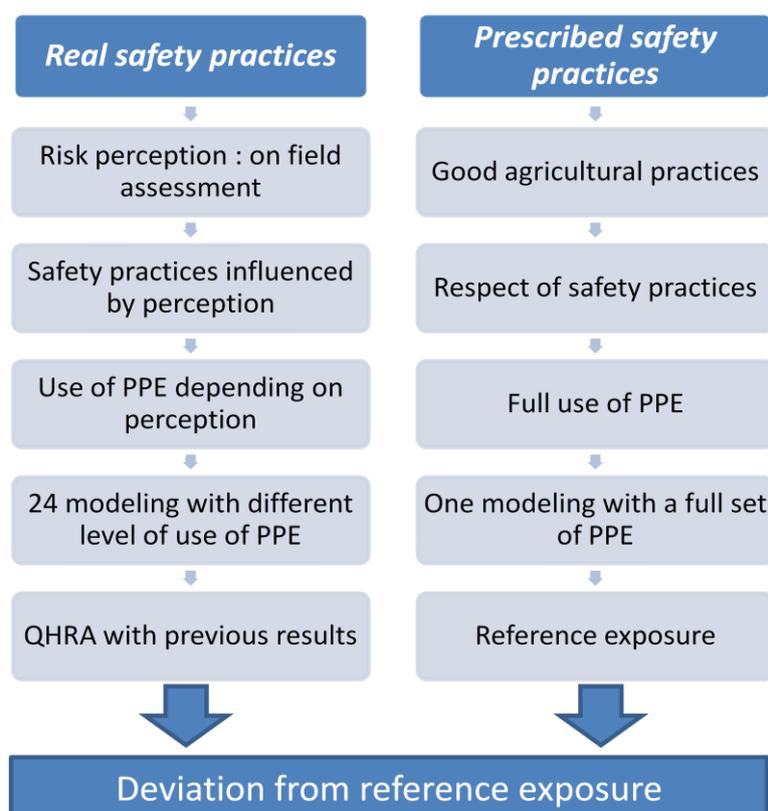
Materials and methods

The determinants of pest risk perception are assessed through interviews of 37 wine producers of the region of Bordeaux. A questionnaire was designed in order to guide the interviews and to collect general information such as experience years, total size of crop, type of pesticides used and the numbers of treatments within a year. The interviews aim to describe the beliefs, knowledge and safety practices of farmers regarding the pest risk.

In a second time, pesticide exposure of vineyards growers is estimated by using the German model for the protection of operators (BBA 1992). This model is one of the two references models used for pesticide registration by European authorities to assess exposure during mixing, loading and spraying pesticides. The German model allows assessing impact of different levels of use of PPE when mixing/loading or spraying.

Comparison of real with perceived safety practices will reveal exposure differences under influence of risk perception. Global methodology is schematize figure 1

Figure 1: Methodology of comparison between real and prescribed safety practices



This figure resumes the global approach to assess difference between real practices and prescribes practices. The use of quantitative health risk assessment (QHRA) in agriculture (US-EPA 1987; US-EPA 1992; US-EPA 2007) permits to assess health impact of risk perception on farmers'. For the left column, different works on risk perception in general population are used (Slovic 1987; Sandman 1993) and adapted to the agricultural environment to create an assessment process suitable for farmers.

The method is applied with the fungicide folpet. Folpet is widely used on vineyards to fight against mildew and odium. Folpet is also probably carcinogenic to humans according to the International Agency for Research on Cancer (WHO 2010).

In a first time, exposure assessment is estimated with the German model. Following parameters are used: 1500g/ha of folpet, sprayed with a tractor-mounted/trailed boom sprayer with hydraulic nozzles commonly used in vineyards. The variable parameters assessed with the model are the use of PPE: gloves, coveralls and respirator mask during mixture preparation and spraying. A total of 24 run of the model is done with different level of use of personal protective equipments at different phases of treatment.

In a second time, the exposure results are used to assess health risk for an occupational lifetime use of folpel at maximum authorized doses. The use of this "worst-case scenario" protects and covers the largest number of farmers. The folpet toxicological reference dose given by the US-EPA IRIS database used is 3.5E-3/mg/kg/day (US-EPA 1993). To characterize the carcinogenic risk for folpet, the following parameters are used: 3 treatments of 8 hours within a year (maximum treatments of folpet authorized in a year) during 41.5 years (the number of working years in France for a full rate retirement).

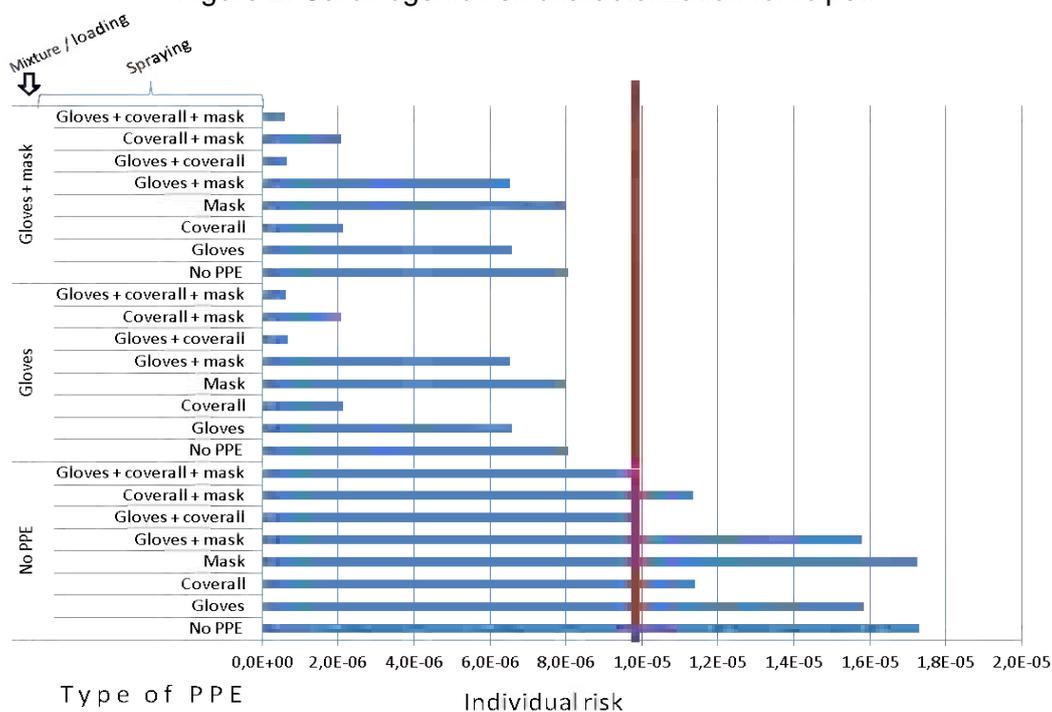
Results

Parameters influencing perception of risk are empirical, without scientific basis and often based on farmer's previous experience with risk. Sensitive parameters like the smell, the shape and therapeutic class of the product (e.g insecticides) are highly influencing the perception of risk. Even if odor of a substance is not a reliable indicator of toxicity (Dalton 1996), a majority of farmers estimate that an odorant pesticide is more dangerous than a pesticide without odor. The most efficient products on crops are also those perceived as the most toxic to humans. 80% of interviewed farmers were trained to "Certiphyto" a mandatory training being deployed in France on good practices of pesticides usage. During this training the dermal route is shown as the main. Yet 72 % of farmers believe that the respiratory route is the main route for exposure. This result indicates the strong impact of the environment on perception. The odors of substances, the dust of powder products well visible when loading and the fog behind the tractor when spraying are frequently quoted by farmers to illustrate their opinion. Logical associations are important in the mechanism of risk perception.

The folpet is perceived as dangerous by farmers because of its strong odor. This leads to greater use of the respirator rather than gloves or coverall. Personal protective equipments use is under direct dependence of risk perception.

The use of QHRA method make the link between perceived risk that influencing safety practices (wearing PPE) and the real risk. The use of PPE is the most direct and visible marker of perception of risk. The risk characterization is depending on the degree of use of PPE. Figure 2 show the carcinogenic folpet health risk impact depending on the use of PPE during mixing/loading and spraying.

Figure 2: Carcinogenic risk characterization for folpet.



Models revealing a risk in excess (greater than $10E^{-5}$) associated with exposure to folpet with no PPE usage. Coveralls and gloves significantly reduce the risk: the risk becomes acceptable in any cases if gloves are used during preparing the mixture. Folpet safety data sheets recommend using gloves and coverall when using the products (BayerCropScience 2009). If farmers respect the use of recommender PPE, the risk remains acceptable for a use at maximum recommended doses.

Risk protection associated with folpet use is high for respiratory route. For odorant pesticides, reparatory mask is more likely accepted and wore than for non odorant pesticides. Figure 2 shown that impact of the respirator mask on the risk is negligible in accordance with exposure studies (Baldi, Lebailly et al. 2006). It's contrasting with the feeling of farmers who thinks this mask is very important especially during mixing and loading phase and less important when spraying. The activated carbon and dust filters on cabins are perceived as an effective barrier against pesticides sprayed.

The risk assessment shows overexposure and an excess of risk related to misperception of risk. Wearing respirator masks, seen as important by farmers and well accepted, come at the expense of other equipment (such as gloves or coveralls) or other risks such as physical risk however the most important among farmers (Waggoner, Kullman et al. 2011).

Discussion

Factors influencing risk perception are not suitable markers for assessed real toxicity of products. But their impacts are strong on farmer's perception of risk. The sensitive parameters like the smell or the type of products are available without effort and allow a quick and easy self-evaluation of pesticide toxicity (Dalton and Jaén 2010). The impact of these determinants remains strong and supplants a risk assessment necessitating more involvement of farmer like training to good use of pesticide or seeking information on the toxicity of products: current economic and environmental challenges unfortunately make the health protection of the farmer secondary.

The use of computer models is a fast and reliable way to assess exposure of farmers associated with different parameters. In this study, impact of PPE use can be assessed quickly with the German model. Forms of pesticides are limited and the models do not take into account of granules or new formulations of pesticides like water soluble packets. Few types of sprayers are also proposed and only one is suitable for vineyard crops. Our field observation revealed different types of sprayers used and sometimes homemade sprayers. All these parameters are not yet included in the models whose design dates back several years now. Models also consider PPE as new and adapted to pesticide protection. The situation in the farms is different with sometimes used or inappropriate PPE (leather gloves, PPE in unsuitable material). The main problem is the respirator mask because it's hard for farmers to evaluate the condition of the cartridge and to determine when to change it. The models also consider the presence of activated carbon filters, dust filters on pressurized tractor cabin, but those equipments are not always present or used on the cabins. If models are still incomplete they remain useful and reliable to assess parameters they include.

The 24 models indicate an exposure of 0,073 mg/kg/day if gloves and coverall are use during treatments. This exposure remains under the Acceptable Operator Exposure Level or folpet (fixed at 0.1mg/kg/day by the UE (EFSA 2009)). This confirms the importance of PPE and

the respect of instructions provided by safety data sheets. Safety recommendations for folpet help keep exposures below AOEL.

The use of the "worst-case" scenario to the QHRA should be a reason to minimize these results or extrapolated to all pesticides. Indeed some parameters cannot be assessed yet. First, the lack of toxicological data on the carcinogenic effects of pesticide induced that many substances are not currently testable. Few pesticides are classified in carcinogenic databases of the WHO or US-EPA. Then, many pesticides are used in association to increase efficiency of treatments. The impact of mixtures of chemicals substances is yet poorly known. To finish, toxicological effects of degradation substances formed from pesticides under effect of sun, temperature or water are unknown. It remains many uncertainties concerning toxicological effects of pesticides.

Conclusion

By comparing real risk with percept risk, we estimated health impact under influence of farmers' perception of pest risk. Safety pesticides are highly influenced by risk perception. The health risk perception is not global but product dependant: some pesticides are percept as dangerous and other ones to be safe. Respect of safety practices and in particular wearing personal protective equipment depending on self-estimation of product toxicity and estimated exposure route. Determinants of the danger are often empiric and based on sensible criteria like odors or type of pesticides. It results a misperception of risk leading to a low usage of PPE or the use of inappropriate equipments like a respirator mask instead of gloves or coveralls.

The health risk assessment for the folpet reveals a carcinogenic health risk in excess can occur associated with the use of this substance without protection. Risk became acceptable if PPE are used especially coverall and gloves. These equipments are recommended by the folpet safety data sheets. This result confirms importance of PPE for reducing risk. It also quantified the health risk associated with perception of risk and its influence on PPE usage. The previous results must be confirmed by futures field samples. A difference of exposure between a pesticide perceived as safe and another one as unsafe should valid previous results.

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