Application of XAD-2 passive samplers for the evaluation of the atmospheric contamination by pesticides

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General Purposes

Actually, methods used to evaluate the atmospheric contamination by pesticides need high volume samplers followed by solvent extraction, purification and analysis by chromatography. This technique is well known and effective, but presents some drawbacks, especially when sampling campaigns are generated in a large scale and for a long time. Samplers need a power source (ie electrical – not easy on the field) and time consuming laboratory practice. An alternative to the use of passive samplers which are inexpensive, easy to use and to deploy in a large scale. If the concept and theory of passive sampling are well known, many works need to be performed from both a fundamental and practical points of view, mainly on extraction and purification processes after sampling. Moreover, the applicability of passive sampling to polar compounds also requires improvements. Indeed, in the current literature, only lipophilic compounds are considered, probably due to their easiness of extraction and analysis. The aim of this study was to exposed XAD-2 based passive samplers to assess outdoor air contamination by pesticides. The sampling device, on which absorption of pesticides occur, containing absorbant materials (XAD-2 type) resists in proportions allowing an extraction with ASE (Accelerated Solvent Extraction) using little or no-organic solvents. Passive samplers were deployed during pesticides application periods in urban (Strasbourg) and rural (Sand) area in France, and sampling was done during a 15 days period from 2011 to 2012.

Materials and Methods

Pesticides were analyzed using a VARIAN GC 3900 equipped with a mass spectrometer SATURN 2100 (m/z trap). All pesticides were analyzed by MSMS in EI mode. Detection limits varied from 0.05 to 6 ng/sample with variations ranging from 7.2 to 19.7 % (inter-day) and from 9.3 to 22.5 % (intra-day).

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Evaporation of solvent to 1 mL in a rotary evaporator

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After exposition, the sampling tubes were extracted following the outline presented below

<table>
<thead>
<tr>
<th>ASE conditions</th>
<th>SOLVENT : acetonitrile</th>
<th>HEAT : 7 min.</th>
<th>STATIC : 15 min.</th>
<th>FLUSH : 100 %</th>
<th>PURGE : 300 sec.</th>
<th>CYCLES : 3</th>
<th>PRESSURE : 1500 psi (103.38 bar)</th>
<th>TEMPERATURE : 150 °C</th>
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</table>

Sampling tubes were made at dimensions compatible with the extraction by ASE (direct introduction into 100 mL ASE 300 cells) and allowing an easy manipulation in the field. In order to protect these tubes towards potential hazards (wind, rain ...), when exposed in the field, shelters were made as shown on figure 1. The tubes were filled with resin XAD-2®. This resin was chosen as adsorbent because of its "very good retention properties for the monitored atmospheric pesticides (Dobson et al., 2008).

Figure 1. Photo of a passive air sampler and its shelter (behind).

Figure 2. Comparison of the sum of detected pesticides between the urban and the rural site.

Figure 3. Comparison of the amount of selected pesticides between the urban and the rural site.

Results and Discussion

Conclusions and Perspectives

XAD-2 passive samplers seems to be a good alternative to high volume samplers for the quantification of pesticides in the atmosphere. This method allows an easy evaluation of the spatial and temporal variability of the contamination depending on the localisation and agricultural activities.

Considering individual pesticides, the amount of pesticides is higher in the rural site (figure 3), with a dominance of 5-methylcar and acetochlor as Me5. This can be explained by the prevalence of maize crops. In August, propiconazole increasing is supposed to be due to the proximity of vineyards probably carried by the wind until the rural site.

Reference: