Introduction

Volatilisation of pesticides from plant surfaces is an important pathway of environmental exposure. Factors contributing to high concentrations of pesticides in air in glasshouses are:

- high temperatures
- physico-chemical properties of the pesticide
- low ventilation

⇒ Up to 90% of the applied dose can dissipate through volatilisation. Due to this, workers performing activities in glasshouses are potentially at risk but research on air concentrations in glasshouses after application of pesticides is scarce.

Objective

This study aims:

- to measure the concentration of pesticides in a greenhouse
- to follow up the pesticide concentration in air in time
- to find options to mitigate the worker exposure and presence of volatilised pesticide in the environment

Materials and Methods

Volatilisation experiments

The concentration of the pesticides fenpropimorph and pyrimethanil in the air compartment was measured in a greenhouse of 700 m² until 3 days after application. Pesticides were applied at 10 AM, using an automated spray boom:

- pesticide dose: 0.032 g.m⁻² fenpropimorph and pyrimethanil
- surface: tomato crop
- sampling: at breathing height (1.6 m) and at crop height (2.5 m)

Consecutive sampling periods of 15, 30, 60 and 120 minutes started as soon as the pesticide spray was settled down after application. For the days after application, sampling periods of two hours were taken in the morning and afternoon. The sampling flow rates were 0.09 m³.h⁻¹ at the center of the greenhouse and 2 m³.h⁻¹ at the side. Average temperature was 18.4 °C inside the greenhouse and 6.7 °C outside the greenhouse. Average wind speed outside the glasshouses was 1.04 m.s⁻¹. Experiments were performed with closed windows. Ventilation was determined to 0.04 h⁻¹ with the dynamic tracer gas method. Four replicate samples were taken at each sampling location and height

Adsorption material

In the experiments, the sampled air was brought over sampling tubes with cleaned XAD-4 tubes, Figure 1, with a sampling area (A) and a breakthrough check (B). After sampling, the contents of the sample tubes were desorbed with hexane and analysed by a gas chromatograph (Agilent Technologies) equipped with a mass selective detector.

Results and Discussion

Concentrations of fenpropimorph in the air were higher than the concentrations of pyrimethanil, as was expected based on the vapour pressure of both components. Concentrations of the pesticides were found to be the highest at the center of the greenhouse, between the rows of the tomatoes. The concentration of fenpropimorph and pyrimethanil in air is given in Figure 2 and 3 respectively.

Small differences were observed at different sampling heights. Although both pesticides are reported to be (semi-) systemic, they were still detected at 3 days after application.

In general, samples taken in the morning showed lower concentrations of pesticides in the air compared to samples taken in the afternoon. This suggests that pesticide concentrations in the air follow a diurnal cycle.

Conclusions

The volatilisation of fenpropimorph and pyrimethanil from a tomato crop:

- reaches a maximum during the first few hours after application
- decreases substantially with time, but pesticides are still detectable for 3 more days
- shows a higher concentration of the pesticides in the afternoon than in the morning

Based on these results, an application of pesticides in the evening seems advisable because of lower prevailing temperatures at that time. Also, after application it is advised to avoid working in the glasshouse at high air temperature and to adhere to the re-entry time of the products. Finally, if possible, it is advised to select pesticides not only with the lowest toxicity but also with the lowest vapour pressure.

The next step in this research will be to examine other plant surfaces and ventilation rates. Other pesticides and sampling periods will be evaluated as well.

References