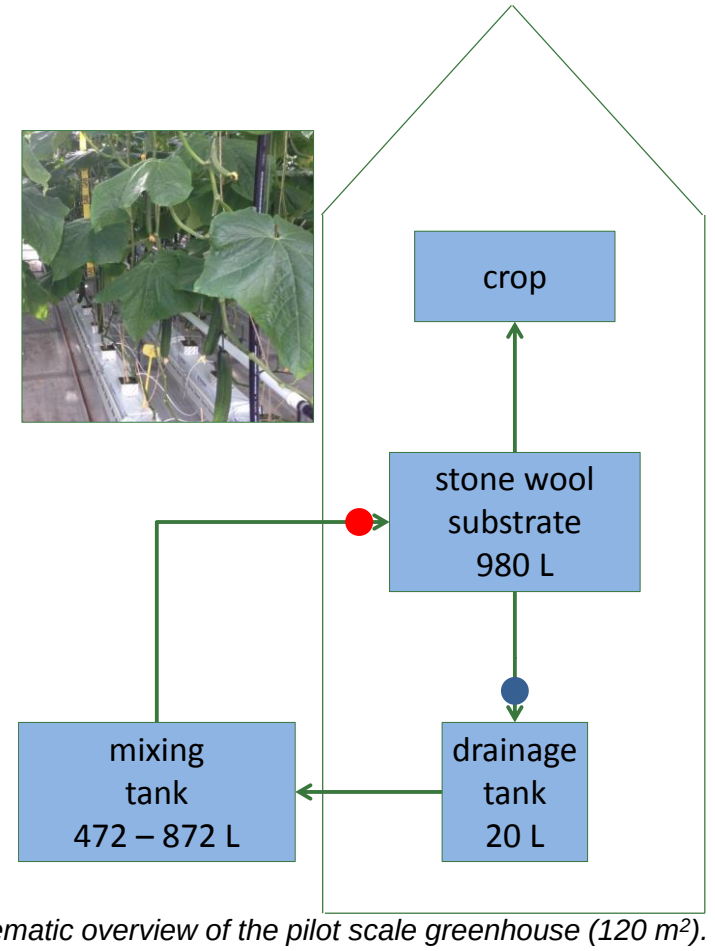
National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

Validation of the Greenhouse Emission Model for soilless cultivation

Conclusions

- simulated and measured concentrations compared well, from 36 to 80 h after application onwards
- plant uptake appeared to be the major dissipation route, 34 - 54% was taken up in 6 days
- concentrations in the system support the TSCF concept

The Greenhouse Emission Model (GEM) has been developed to evaluate emissions of plant protection products from greenhouses to groundwater and surface water. Both soil-bound and soilless growing systems are included in the package. As up till now there is little experience with emissions from soilless growing systems, it was considered appropriate to perform an experiment at pilot scale and test the model. The experiment was run for 6 days and concentrations in the system were measured. GEM was adapted to the lay-out of the experiment and simulations were performed using measured water flows as input.



Schematic overview of the pilot scale greenhouse (120 m²). Substances dimethomorph, fluopyram and imidacloprid were applied with the nutrient solution to a standing cucumber crop with the nutrient solution. Samples were taken from water flowing into and out of the substrate. The mixing tank served as water reservoir as well. Fresh water (400 L) was added when the water content of the mixing tank dropped below 472 L.

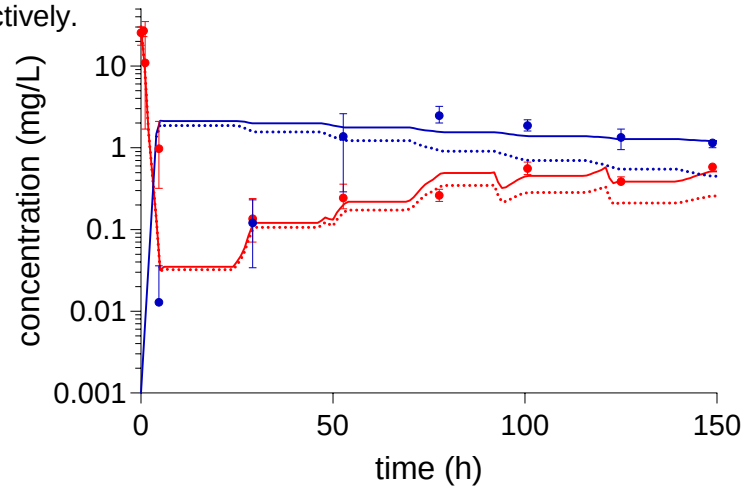
Ref: RIVM report 2016-0063

Results

Fluopyram (see figure below) and imidacloprid behaved very similar in this system at pilot scale. Supply of substance-free solution after the start causes concentrations to drop down very quickly. Recirculation of drain water causes concentrations to rise again. Concentrations in drain water are overestimated in the simulations up to approximately 50 h after the start. Perfect mixing in tanks and stone wool, as assumed in the model, is apparently not achieved shortly after application. For dimethomorph , agreement between measured and simulated concentrations was reached after approximately 80 h. The longer time is attributed to exceeding the solubility in water in the first days of the experiment. Degradation appeared negligible over the course of the experiment.

Plant uptake and Transpiration Stream Concentration Factor

Uptake of substances is different from uptake of water and is modelled using the concept of TSCF. Consequently, concentrations in drain water are higher than in supply water. Based on their K_{OW}, TSCF-values are 0.56, 0.3 and 0.47 for dimethomorph, fluopyram and imidacloprid, leading to 54, 34 and 45% plant uptake respectively.



Fluopyram concentrations in the recirculating water in the system. Red: into, blue: out of the stone wool. Dots: measurements, lines: simulations. For comparison, the dotted lines give the results for TSCF = 1, clearly to high a value for fluopyram.

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