Pesticide screening in water courses draining commercial greenhouse areas in southern Sweden, 2017-2018

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Summary

This report presents results from a screening study on pesticides in water courses draining greenhouse growing areas. The aim was to determine the extent of pesticide leaching from greenhouses following measures taken by growers and authorities (e.g. regulation and training) in recent years.

The study was carried out in seven different water courses. Sampling upstream and downstream from greenhouse areas was performed in some of these water courses, resulting in a total of 11 sampling sites. The catchment area at the sampling sites downstream from greenhouses varied widely, from 1 to 212 km^2. Sampling was conducted over an entire year, from summer 2017 to summer 2018, since pesticides may be used in greenhouse cultivations during most of the year.

The sampling sites were selected to represent vegetable production and ornamental plant production. The greenhouse establishments included in the investigation were in most cases representative of Swedish greenhouse enterprises, although they were larger than the average in most cases. All establishments comprised a number of greenhouse buildings, constructed over several years. In all cases, there was agricultural land in close proximity to the sampling sites. Based on the sampling regime, the study should be regarded as a general investigation of pesticide losses from greenhouses, and not as recipient monitoring of individual enterprises.

Samples were collected using two different techniques, grab sampling (all sites) and time-integrated TIMFIE sampling (four sites). Samples were taken every 14 days during the entire sampling period. The grab samples were analysed for 148 compounds when taken at sites downstream from ornamental plant production enterprises and for 124 compounds when taken at other sites. The TIMFIE samples were analysed for 106 compounds.

A total of 105 different compounds were detected in water samples on at least one occasion during the sampling season 2017/2018, of which 92 were found in grab samples and 80 in TIMFIE samples.

The highest concentration of an individual compound in grab samples was 107 µg/L of propamocarb, while in TIMFIE samples the highest concentration was 298 µg/L of the same compound.

The total pesticide concentration varied between areas, with consistently higher values in water samples taken at a sampling site (GB7) with the smallest catchment area and the highest number of greenhouses within the catchment. Three other sampling sites, SP8, VB9 and SN10, had a number of elevated total concentrations. These sites also had the highest frequency of samples exceeding the Water Quality Objectives (WQO). A total of 25 different compounds reached or exceeded their threshold level in at least one grab sample, while the corresponding figure for TIMFIE samples was 17 different compounds. Most of the values above WQO in grab samples were recorded for the herbicide diflufenican (20.9%), followed by the insecticide imidacloprid (19.4%) and the degradation product endosulfan sulfate (17.5%). Imidacloprid was the compound that exceeded its WQO level by the greatest margin.

Comparisons between the time at which a compound was detected in water and the time of use of that same compound in greenhouses in the area, and between upstream and downstream sampling sites, indicated a link with greenhouse use for some compounds. These were: acetamiprid, azoxystrobin, boscalid, cyprodinil, fludioxonil, hexythiazox, imazalil, imidacloprid, carbendazim (from thiophanate methyl), pirimicarb, propamocarb, propiconazol, pymetrozine and pyraclostrobin. Most of these compounds for which measured concentrations in water were linked to use in greenhouses were detected at sampling sites SN10 and SB11.

Comparisons between the results of this study and those reported in the Swedish environmental monitoring programme for pesticides (SEMP) in agricultural areas revealed that the total concentrations did not differ markedly, but there were some interesting differences. Some compounds, e.g. endosulfan sulfate, acetamiprid, hexythiazox and imazalil, were not detected at all in SEMP in the period covered by the comparison (2015-2017), but showed a detection frequency in the present study of 35.8%, 17.3%, 7.9% and 5.0%, respectively. Some other compounds permitted for use in greenhouse cultivations were detected in higher concentrations in this study than in SEMP. These were: acetamiprid, fludioxonil, imazalil, imidacloprid, pirimicarb, propamocarb and pymetrozine. The reverse was true for some typical agricultural compounds, such as bentazone, diflufenican and metamitron. As regards WQO levels, imidacloprid was the compound that most frequently exceeded its WQO value in this study (19.4% of samples), compared with 1.1% in SEMP.

Using the results for grab samples in this study, mean annual concentration for each compound was calculated, to enable comparisons with the Environmental Quality Standards (EQS) used for status classification within the Water Framework Directive. The compounds that exceeded the EQS on at least one sampling location were diflufenican, imidacloprid and pirimicarb. However, it is important to point out that all these sampling locations were not in a catchment big enough to be a water body, where the EQS is legally binding, according to the Swedish water management.

Some compounds that probably derive from greenhouse use were frequently detected at elevated concentrations. Other compounds known to be used in the greenhouses in the study catchments were seldom or never detected. These differences probably depend largely on the amount of pesticide used, the application technique and the chemical properties of the compound.

The results indicated that the risk of pesticide losses varied between the different greenhouses studied. Pesticide losses from greenhouse growing are also an issue attracting attention in other countries. Risk areas often identified include recirculation systems that are not completely sealed, inappropriate storage of pesticides and applying the compound by watering the cultivations. The latter was confirmed by the results in this study, which showed that the highest measured concentrations of active compounds were those applied by watering. The results in this study also indicated that compost stored outdoors can give rise to pesticide losses.

There are technical solutions available that can reduce the risks, but much can be achieved by better handling procedures. Finally, as always it is important that growers follow the principles of integrated pest management by minimising use of chemical pesticides and by employing the biological and non-chemical methods available.

The report (in Swedish) is available for download: https://www.slu.se/ckb/rapporter-fran-ckb