



## Meeting minutes from workshop on leakage of pesticides from greenhouses

2020-12-11, 9.20-16.00, Microsoft Teams

**Participants:** see separate document

Presentations were given by representatives from Sweden, Denmark and The Netherlands – see program included in the end of the document for titles and speakers, and separate pdf:s for the presentations.

### Short summary for each country

**SE** – SLU study in 2008 showed pesticides in small streams outside greenhouses - the greenhouse industry started to work with measures to reduce leakage – SLU study in 2017-2018 did not show any decrease in the risks of leakage. This motivated further work with risk reduction, technical solutions, courses for growers, measurements etc. In Sweden we are now working together to find solutions and this workshop was a part of that cooperation. Other studies made by for example the County Administrative board of Skåne also show leakage. In Sweden the municipality is responsible for inspections in greenhouses. Helsingborg municipality has 20-25 % of Sweden's greenhouse production and they are working intensely with these questions and have ongoing work with dialog, inspections, sampling and measures.

**NL** – Greenhouse cultivation is a much bigger industry in NL compared to SE, DK, NO and FI. They have been working for a long time with the environmental aspects, including the issue of pesticide leakage. The goal is to have (almost) Zero emission from the Horticulture in the Netherlands in 2027. Recirculation of drain water and collection and use of condensation water is obligatory. The region Delfland has 41 % of the total greenhouse area. They have an ongoing project with a new approach, to detect and end leakages by measuring more, focusing on areas with bad water quality and work in close collaboration with growers. First inform and give advice about the legislation then give enough time for doing the changes, 1y -> 3y.

**DK** – In DK the EPA published a national guidance document in 2019, which is a clarification of general environmental regulations regarding pesticides and greenhouses. The guidance covers the issue of open/closed buildings, in relation to how pesticides are approved for greenhouses and in open field, what is done with plant waste and waste water etc. Pesticides for use in open greenhouses must be reapproved. Discharge of water and plant waste is only allowed outside greenhouses with permission. The municipality of Odense has ~ 45 % of total area of greenhouse production in Denmark. In Odense monitoring of pesticides, nitrate and ortho-phosphate is made up- and down-stream from greenhouses in 1-4 streams in agricultural land since 2011.

The discussions in the afternoon started with short reports about the situation in Norway and Finland, since they did not have separate presentations in the program:

**NO** – Roger Roseth (NIBIO): Monitoring started 2007 in small streams and drainage downstream greenhouses. Found Elevated concentrations of P, N and ~30 pesticides. Both from flower and

vegetable production. Higher levels from flower growing. Also looked at organic waste. Found the same pesticides in the organic waste. No regulation for organic waste – leaching to water. In groundwater for drinking water – found imidacloprid in high concentration (over drinking water limits). Greenhouse business considered like all other agricultural business – in Rogers opinion it should be considered more like an industry production. We should look into how water comes out of the greenhouses and what it contains.

**FI – Niina Kangas (Finnish Glasshouse Growers' Association):** A bit different story than SE and NO. National research was last done 20 years ago on leakage of pesticides and nutrition focused in greenhouses. But regional authorities are following nutrient and pesticide residues in the environment, especially in the agricultural and horticultural areas. Nothing alarming has come up so far, and further research has not been done. Individual companies have done soil nutrient and pesticide analyses when needed. FI has 360 ha greenhouses, 1/3 ornamentals, 2/3 vegetables. 5 % of the ornamental producers are big companies that produce year around. A lot of work on environment by the growing organization Niina represents – focused lately on carbon footprint – pesticides and nutrients are the next step.

### Questions we asked the presenters from each country to address and conclusions from the workshop

- Characterization of the greenhouse industry in each country (greenhouse types, number, size, age, recycling etc.)?
  - SE: Agricultural area 2.6 Mha, 13.000 ha horticultural crops, 744 greenhouse companies, 286 ha greenhouse area. 50% ornamental pot plant production, 50% vegetables (cucumbers, tomatoes) or berries. Vast majority of greenhouses are old and low-tech buildings. Ca 60 % of greenhouse area has recirculation system but only 34 % of the total number of companies.
  - NL: 9000 ha greenhouses, 3500 companies, 15% of the number of companies > 5 ha and 40% <1.5 ha. Many greenhouses are high tech. Recirculation of drain water and collection and use of condensation water is obligatory. Major crops: tomato (1700 ha), sweet pepper (1200 ha), cucumber (550 ha), strawberry (350 ha), rose (250 ha), gerbera (160), chrysanthemum (soil) (450 ha) and potted plants (2000 ha).
  - DK: 441 ha greenhouses. 272 ha >20 years old. 91 % of the area recirculated (statistic from visit in 41 greenhouse nurseries, 2015). 75 % of the area is recirculated in the municipality of Odense. Today 5-10 % is closed production area, old (>20 years) productions are difficult to close.
- Are there any specific regulations concerning measures to reduce the risk of leakage from greenhouses? Are there conditions of how to use the different pesticides allowed in your country?
  - In general, there are slightly different interpretations and implementations of the regulations in the different countries. Only NL has specific regulations for greenhouses. DK has a guidance which the EPA published in 2019, which is a clarification for greenhouses, of general environmental regulations. In SE no specific regulations for greenhouses. There are general rules around applying and handling pesticides and specific conditions of how to use the different pesticides. In general the environmental law in Sweden is based on goals, the companies' own responsibility and inspections.
- What measures have been taken so far? Has it worked well? What have been the challenges and are there any problems that are still not solved?
  - The countries have taken different approaches and are more or less far from solving the issues, due to different situations and starting points. See presentations for details. See below for detailed questions whereof some are not solved.

- How do the greenhouse operators react to the work?
  - In SE the impression is that the growers want to do the right thing but need more knowledge and guidance on the best methods and how to solve the problems in a practical way.
  - In Delfland, NL, the impression is that the authorities try to find shared interests and collaborate with growers to find solutions.
  - In DK the growers find the new guidance strict. They are working on it and want to cooperate, but are sometimes overwhelmed by the stricter implementation of the general environmental legislation.
  
- Is there a possibility for financial compensation for investments / measures?
  - In DK there are subsidies for establishing recycling of irrigation water.
  - In SE and NL there are no specific compensations for this at the moment.
  
- Are measurements outside the greenhouses made to follow the measures?
  - Continued measurements of pesticide leakage in Delfland, NL.
  - In Odense, DK, sampling up- and down-stream in 2-3 streams +/- 1 stream in agricultural land since 2011.
  - In SE no continuous measurements outside greenhouses. Intermittent sampling projects.
  
- Are inspections from authorities being carried out in the greenhouses? How frequently?
  - In NL more advisory than enforcing visits. Try to give the growers time to make adjustments.
  - In DK the municipality and agricultural agency do inspections.
  - In SE the municipality does inspections and the Board of agriculture gives guidance on surveillance to the municipalities. The growers pay for the inspections, which is not the case in NL and DK.
  
- Have you succeeded in reducing the levels in your surface waters?
  - Difficult to answer in general. The countries have worked on this issue during different amounts of time. No quick fixes, the issue takes a long time to solve.

### Detailed questions we asked presenters to address

- How is the condensation water handled?
  - See details in presentations.
  - Condensation water from walls is not handled in any of the countries. The size of the greenhouse decides how important condensation water from walls is compared to water from the ceiling – more important issue in SE and DK than NL. In DK work is done to minimize pesticides in condensation water, including from walls, by alternative application technique. Further work is needed.
  
- Where does the water from cleaning of the filters, water tanks and basins go?
 

Where does the water from cleaning the greenhouse go? What does it contain and is it collected?

  - In NL and DK the cleaning water from filters and basins has to be kept inside the growing system as far as possible. In DK it is typically spread on soil which requires a permission depending on which pesticides and heavy metals and concentrations is in the sludge/sewage water.
  - No available good techniques to collect cleaning water when cleaning the greenhouses.
  - There are few available measurements of pesticides in water used for cleaning after finished culture and cleaning of filters and basins – more work needed. Erik van Os mentions that

measurements have been done the last 2 years, there is a report in Dutch (<https://edepot.wur.nl/477551>) but might be published in an English paper.

- In NL and DK a waste company can take care of the water/sludge if it needs to be let out and contains too much pesticides. More solid sludge can be disposed of at the incinerator plant combusting waste. In SE in some cases the sludge is taken care of by a waste company.
- Handling of the compost material
  - In DK and NL organic waste containing (some certain) pesticides has to be stored in a closed container and removed by waste company.
  - In Sweden it is usually put on the ground outside, sometimes spread in an agricultural field. There are no established systems for handling it in another way.
    - To place plant material outside on biologically active areas, e.g. grass, is not allowed in DK, NL, if it contains (some) pesticides.
- Safe location for filling the sprayer
  - An important issue. There are good ways of handling it. See details in presentations.

### Other discussed issues and their conclusion/answer

- Is there a correlation between time of application and time of detection of pesticides?
  - Sometimes, but pesticides can also leak at other times, for example when cleaning after finished culture, or leaching from compost.
- Is there a difference in risk between ornamental vs vegetable production?
  - There are differences in what substances are used and how they are applied. Both leak, but in different ways.

### Unanswered questions and issues for further discussion

Below is a compilation of questions which were not answered during the workshop, and comments on these questions from the Swedish group. There are also some issues which do not have any answer and could be further discussed. We have focused on including questions related to practical measures for reducing leakage and excluded some questions about e.g. registration of pesticides. This could be the topic for another workshop. Some questions specific for Sweden have also been excluded.

- Are there drainage tubes under the greenhouses or is the water diffusely leached from the ground?
  - Klara Löfkvist: In newly constructed greenhouses in Sweden, no drainage under the foundation is made but drainage around the outer walls is normally made. In older greenhouses some might be placed on old agricultural areas where there might be old drainage systems. But they are probably not in function. Many old greenhouses is though not placed on places where there have been drainage before and then there probably are no drainage. So it depends on the place and age of the greenhouses. Not so many growers have the knowledge regarding the ground of the greenhouses in detail.
- Have groundwater investigations been done in Sweden?
  - Gustaf Boström: There have been investigations of pesticides in groundwater made in Sweden but we don't know of any study that is focused on ongoing leakage from greenhouses to groundwater. There have been a few measurements of groundwater at old decommissioned horticultural businesses where they found BAM, atrazine, simazine and 6 other substances. More work could be done.
- Are there any general conclusions from the 35 visits to companies in Sweden?

- Klara Löfkvist: The growers want to solve this problem but is not aware of all the precautions that have to be done, in order to prevent the leakages. The magnitude of a very small leakage is still difficult to get the right perception on. Some of the measures is easy to do but some demands a total rebuilding of the greenhouses. Both money and time is problematic to find. Almost all growers have great possibility to improve their handling routines with larger awareness.
- Are there any special demands on building standards to prevent leakage of pesticides when the growers want to construct a new green-house?
  - In SE there are no special demands at the moment.
  - In DK there are no special demands and leakage can normally only be discovered and regulated after the building of greenhouses. In Odense they try to encourage the grower to think in closed systems eg. concrete floor or tight membranes /other when discussion new production facilities.
  - In NL:
    - Need different permits and construction plans that show that it's a closed system
    - Condensation water from the cover has to be collected and to be used first
    - Run-off from courtyard to ditch is forbidden; it has to go to sewage system or special tank
    - In the greenhouse construction itself there are no regulations for PPPs
- What about the PPP's left in the recirculation water? How do the growers account for it when applying PPP's?
  - Klara Löfkvist: It is not necessary to account for since the levels are very low relative to the dose normally given to the plants. However, the levels in the recirculating water are high in relation to the extremely low levels allowed in surface waters.
- Can UV-light be used to reduce the use of PPP's in greenhouses?
  - Klara Löfkvist: Yes if the water flow through the UV light is slow and if it is combined with H<sub>2</sub>O<sub>2</sub> (advanced oxidation). If you want to clean the water from chemicals hydrogen peroxide is first added and then the water is lead slowly through the UV light (254 nm).

UV light can also be used to clean the water from pests and diseases and then you first lead the water through the UV light and then add hydrogen peroxide so that the algae that might be in the water is broken down.

- What was the results of the monitoring inside the greenhouses in NL?
  - They measured drainwater, see report in link.
  - Condensation water was measured on PPPs by Jim van Ruijven very recently (2021).
  - Results from measurements of PPPs in the condensation water in report by Van der Linden (2017), <https://edepot.wur.nl/421122>
  - There is a report about the Greenhouse Emission Model validation measurements: <https://research.wur.nl/en/publications/testing-of-the-greenhouse-emission-model-for-application-of-plant>

### Future cooperation

Many participants are interested in a continued collaboration on these issues. Suggestions are to establish a network and to have a meeting in 2021-2022. If possible, if a research call opens up for an EU project on these issues, the Swedish workshop participants are positive to make a joint application.

Anne Fabricius mentions they have an ongoing project on drift and invites workshop participants to take part.

Suggestions that more growers and technical companies should be involved in a network. From Norway also suggestions to include e.g. the food safety authority and parts of NIBIO developing greenhouse technologies.

A few days after the workshop, in Sweden we got financing for a study on how fly larval composting (FLC) can contribute to finding a solution to an industry-wide concern, but also to develop a better handling of the plant nutrient-containing residual streams. Project period 2021-2023. We'd be happy to share results when they are available.

## Program

<b>9.20</b>	<b>Start up</b>	
9.30	Introduction	<b>Mikaela Gönczi</b> , SLU CKB <b>Sunita Hallgren</b> , Swedish Plant Protection Council
9.45	Swedish monitoring results	<b>Gustaf Boström</b> , SLU CKB
10.10	Ongoing work in Sweden to reduce leakage from greenhouses	<b>Klara Löfkvist</b> , HIR Skåne
<b>10.35</b>	<b>Coffee break</b>	
10.45	Inspection and monitoring in Helsingborg	<b>Malin Kylmä &amp; Ena Segerfeldt</b> , Municipality of Helsingborg
11.00	Water flows and emissions in Dutch greenhouses	<b>Erik van Os &amp; Jim van Ruijven</b> , Wageningen UR Greenhouse Horticulture
11.30	Improving water quality in a horticultural area	<b>Djoline van den Berg</b> , Delfland Water Authority
<b>12.00</b>	<b>Lunch</b>	
13.00	Policy and practice within the adaption to general environmental rules in greenhouse productions	<b>Inge Ulsted</b> , HortiAdvice <b>Anne Fabricius</b> , the Danish Horticultural Association (Dansk Gartneri)
13.30	Environmental perspectives on greenhouse production in the municipality of Odense, and monitoring of pesticides downstream greenhouse areas	<b>Pernille Folker-Hansen</b> , Municipality of Odense
14.00	Discussion	
<b>14.30</b>	<b>Coffee break</b>	
14.45	Discussion	
15.45	Conclusions	
<b>16.00</b>	<b>End</b>	