



The Danish Environmental Protection Agency's supplementary framework for the environment for plant protection product uses in open greenhouses, version 1.2:

Content

Background	1
1 Assessment.....	2
1.1 Persistence	2
1.2 Soil characteristics	2
1.3 Precipitation/watering practices	3
1.4 Year vs. growth year	3
1.5 Condensation water.....	3
1.6 Number of production cycles per year pr. greenhouse area	3
1.7 Groundwater	4
1.8 Evaporation	7
1.9 Non-target organisms (except bees)	8
1.10 Bees	8

Background

In November 2019 The Danish environmental Protection Agency (DEPA) published guidance document concerning pesticide containing waste water and plant/media waste from greenhouses: *Vejledning om pesticidholdigt spildevand og pesticidholdigt affald fra væksthushortnerier* ([Vejledning nr. 38](#)), referred to as the Horticulture guidance (*Gartnerivejledningen*). Prior to this guidance all PPP authorisations were implicit for closed greenhouses where the environment is not exposed to pesticides. The guidance gave the possibility to authorise plant protection products (PPPs) for use in greenhouses which do not fulfil the criteria for closed greenhouses. Therefore there is a need to supplement the national regular framework for assessment of pesticides¹ with descriptions of which aspects to include in the environmental risk assessment of PPP use in open greenhouses.

This document contains the supplementary framework that must be used for the environmental risk assessment of PPP use in open greenhouses² including an overview of the risk mitigation measures (RMMs) that are often required.

¹ <https://eng.mst.dk/chemicals/pesticides/applications-for-authorisation-after-14-june-2011/evaluation-framework/>

² Open greenhouses do not include tunnels. In DK, tunnels are defined as 'field use' with regard to environmental risk assessment.

1 Assessment

1.1 Persistence

As for field use, active substances for 'open greenhouse use' must not be persistent or have persistent metabolites. For field use, the half-life (DT₅₀) in soil under Danish conditions must be below 180 days (DT₅₀ < 180 days). For open greenhouse use, the conditions are not completely comparable with field conditions. Greenhouse soil is not comparable to field soil cf. soil characteristics (see chapter 1.2.) and precipitation/watering practices (see chapter 1.3.). Therefore, the half-life in soil measured in standard tests (representative for Danish agricultural soil) must be below 60 days (DT₅₀ < 60 days) for active substances and their metabolites. This requirement (DT₅₀ < 60 days) applies to all PPPs which is for use in open greenhouses under conditions where the soil is exposed. It also applies for PPPs which are to be used on plants which are later moved out of the greenhouse to e.g. a container area or a field.

DEPA assesses the use of a pesticide over several years. Over a number of years, point sources of pesticides can arise from greenhouses without condensation drains, which can lead to leaching of pesticides or metabolites to groundwater. It is not possible to risk assess point sources, therefore an assessment of pesticides in condensation water is required (see chapter 1.5).

If active substances cannot be authorised for use in open greenhouses where the soil is exposed due to persistence they may be authorised for watering (ebb-flood) or drip irrigation in open greenhouses. In these cases, DEPA estimates that the exposure to the environment will occur only *via* evaporation (condensation water). In some cases, DEPA can assess whether there is negligible exposure to the environment (see further below). This will partly depend on inherent properties of the active substance and partly on the specific application method and type of open greenhouse. The assessment includes e.g. how the pesticides is applied, how watering takes place, and to what extent the greenhouse cannot be defined as closed. The assessment also includes whether later planting or relocating to container areas/fields is relevant.

Assessment of watering *via* irrigation with shower³ will depend on whether the method can be compared to spraying or watering (ebb/flow systems) in relation to the risk of evaporation of pesticides. As there is no documentation for this, the evaporation from Irrigation with shower is currently assessed to be equivalent to spray application.

1.2 Soil characteristics

DEPA assesses that the soil on the ground of a greenhouse is not comparable to the agricultural soil, which is the background for soil degradation studies and groundwater modelling. The microbial activity is expected to be lower in greenhouse soil (and container areas) than the soil used in standard tests (representing agricultural soil). This is a.o. due to the fact that the soil/ground in a greenhouse does not have a rhizosphere (as it is uncultivated), which is commonly known to significantly impact the microbiota. This results in a slower degradation of active substances and their metabolites, which in turn can lead to a potentially larger accumulation of pesticide residues in the soil. Since there are no specific data available for the degradation in greenhouse soil, a cautious approach is taken in relation to determining the criteria for the degradation rate (currently set to DT₅₀ < 60 days).

³ According to a Danish Grower's organisation irrigation with shower is irrigation with the sprayer without anyh pressure. This way the liquid is not distributed in small droplet but rather runs out of the sprayer. It is like a watering can with a boom attached. This method is most often applied on new/young plants where the pesticide is to have effect on the top 2-3 cm of the soil in the pots.

1.3 Precipitation/watering practices

In open greenhouses, the same precipitation conditions are not expected as for outdoor/field conditions (represented by the weather data included in the FOCUS PELMO model). Although watering takes place in the open greenhouse, overwatering is not expected to be widespread when growing e.g. potted plants placed close together on the ground. Thus, less leaching of pesticide residues is expected compared to field use e.g. as a result of major rain events.

1.4 Year vs. growth year

For field uses DEPA applies a RMM with the term "growth year", which is the period from 1st August to 31st July the next year; this is related to the record-keeping period for agricultural use. At the request of a Danish Grower's organization (HortiAdvice), the term "year" is used for the open greenhouses, which refers to the calendar year.

1.5 Condensation water

According to the Horticultural guidance it is important that condensation water is collected e.g. in condensation gutters. The collected condensation water must either be reused in a closed recirculation system or handled as waste water or waste. In practice, condensation gutters must be positioned so that they collect condensation water from ceilings, walls and gables in greenhouses. Currently, most open greenhouses do not have condensation drains and therefore are not considered to be closed systems.

The following text must currently be included in all assessments of PPPs to be sprayed in open greenhouses:

”Vilkår

Miljøstyrelsen har begrænset viden til at vurdere, i hvor stort omfang der afsættes pesticid i kondensvand i forbindelse med sprøjtning, herunder hvorvidt det giver anledning til en væsentlig miljøeksponering. Derfor har Miljøstyrelsen stillet krav i godkendelserne om at der skal indhentes data i forbindelse med forsøg til belysning af, hvorvidt der sker afsætning af pesticider i kondensvand under sprøjtning samt effekten af risikobegrænsende foranstaltninger, herunder brug af bedst mulig sprøjteteknik mv.”

1.6 Number of production cycles per year pr. greenhouse area

Crops in greenhouses can be grown with several production cycles per year on the same greenhouse area. This must be reflected in the application and be clearly stated in the instructions for use (and GAP table). It should be clearly stated how many treatments are maximum per production cycle, as well as the maximum number of production cycles per year per greenhouse area. Even if the applicant only applies for use on closed production tables (tables that prevent leaching or dripping of water to the ground) with recirculation of water (soil not exposed), or on closed ground surfaces with collection and recirculation of water (soil not exposed), it must be addressed as evaporation of active substance is part of the risk assessment, and the soil can potentially be exposed due to lack of condensation gutters⁴.

⁴ Note that when treatment takes place on closed production tables with recirculation, closed ground surface with collection and recirculation and gutters to collect condensation water from walls and roof the greenhouse is considered closed and this supplementary framework does not need to be applied.

Example: If the GAP table includes 1-3 applications pr. production cycle it is not possible to determine max number of production cycles per year per greenhouse area, as different production cycles are not necessarily treated with the same number of applications. In that case, the GAP must explicitly include *either* max number of production cycles pr. greenhouse area based on worst-case number of applications (each production cycle is treated a max number of times), *or* explicitly include max number of applications per year per greenhouse area and max number of applications per production cycle.

For use in ornamentals and nursery plants the applicant must clearly state max number of production cycles per year per greenhouse area as this may vary a lot between different cultivars. In addition, the applicant must explicitly state if relocation of ornamentals and nursery plants to field or container areas is intended, and the max number of relocated productions cycles must be stated in the use instructions.

The Danish Grower's organization (HortiAdvice) has supplied the following information on numbers of production cycles for various edible crops in Danish greenhouses:

- Tomato, aubergine and peppers: 1 production cycle per year per greenhouse area.
- Cucumber: 2-3 production cycles per year per greenhouse area.
- Lettuce: 5-6 production cycles per year per greenhouse area.
- Fresh herbs: 8-10 production cycles per year per greenhouse area.

Dansk Gartneri has supplied the following information on numbers of production cycles for various non-edible crops in Danish greenhouses

- Ornamentals: 1-5 production cycles per year per greenhouse area.
- Nursery plants: 1-5 production cycles per year per greenhouse area.

1.7 Groundwater

There are different conditions in open greenhouses, which must be addressed in the assessment of the risk of pesticide leaching to groundwater. See also chapter 1.2 above on soil characteristics.

Cultivation on closed production tables with recirculation is not considered to give rise to direct exposure of the soil - and therefore also no leaching to groundwater. See chapter 1.8 below on indirect exposure of soil from evaporation.

Leaking production tables in open greenhouses constitute potential point sources for leaching to groundwater of active substances and their metabolites. Point sources cannot be addressed in the risk assessment; leaking production tables must therefore not occur. Leaching from such a point source cannot be quantified and local groundwater conditions cannot be included in the generic risk assessments for authorisations. Therefore, use on leaky tables cannot be considered equivalent to use directly on the ground.

Application directly to plants placed on/in soil can, on the other hand, be considered a diffuse source with even distribution over the entire field/area equivalent to a field use. For such uses the assessment can be based on existing groundwater modelling for outdoor applications, cf. the assessment framework for PPP assessments and the EU assessment for the active substance.

Cultivation in closed production gutters with collection and recirculation of water gives rise to direct exposure of the soil beneath due to spray liquid which runs off the plants and onto the ground, as well as spray liquid which lands between the production gutters during spray application.

Cultivation with several vertical layers of crops on the same area must be explicitly stated in the application and included in the assessment. This can be the case, for example, if gutters with ornamental plants hung over production tables or are grown in flights (Danish: “*etager*”).

Ornamentals, nursery plants, herbs and some types of lettuce in greenhouses are most often cultivated in pots:

- Watering: If the pots are grown on closed production tables with recirculation, DEPA will equate the use with a closed greenhouse in terms of persistence and groundwater, but not evaporation.
- If the pots are close together directly on the ground/soil in the open greenhouse. The assessment of leaching can be based on already existing groundwater modeling from PPP assessments and from the EU assessment for the active substance for field use (with a focus on ornamental plants, nursery cultures and herbs not having the same interception).

Cultivation of vegetables, e.g. **tomato, aubergine, pepper and cucumber** are most often grown in the ground or in solid growth substrate (sacks/stone wool blocks/coconut blocks placed on the ground without recirculation:

- The assessment of leaching can be based on already existing groundwater modeling from PPP assessments and from the EU assessment for the active substance.
- If there is a closed ground surfaces (cement/concrete or 2 layers of plastic or equivalent) but no collection/recirculation of water only use as drip irrigation can be approved.

Cultivation of **lettuce**⁵ is most often done directly in the ground soil:

- The assessment of leaching can be based on already existing groundwater modeling from PPP assessments and from the EU assessment for the active substance.

Cultivation of **strawberries** in production gutters⁶ or tabletop⁷ with closed ground surfaces or directly in the ground/soil:

- The assessment of leaching can be based on already existing groundwater modeling from PPP assessments (including the RMM “band spray only”) and from the EU assessment for the active substance.

Cultivation of **strawberries** in production gutters⁶ or tabletop⁷ with closed ground surfaces but no collection/recirculation of water:

- No assessment of the risk of leaching of pesticides to groundwater from point sources can be made. Therefore, this cultivation scenario cannot be approved.

Cultivation of **strawberries** in production gutters⁶ or tabletop⁷ **Fejl! Bogmærke er ikke defineret.** with closed ground surfaces and collection/recirculation of water:

- An assessment of whether the criteria for evaporation can be met must be performed.

All scenarios require that the criteria for evaporation are met (see chapter 1.8 below).

The following RMMs will be required and adjusted when relevant (text in blue and possibly a.o.):

⁵ HortiAdvice has stated that, although lettuce is generally grown directly in the ground, it may be relevant to consider the use on closed production tables (or gutters) with recirculation.

⁶ Provided by HortiAdvice.

⁷ <https://dcapub.au.dk/difpublikation/difpdf/gvha175.pdf>

For use in ornamentals and nursery plants grown in pots placed on the ground without recirculation: To protect groundwater do not exceed the max application rate per year given in the instructions for use. Furthermore, in the same year, other products that contain active substance(s) must not be used on the same area.

Ved anvendelse i pryddplanter og planteskolekulturer dyrket i potter på jorden uden recirkulering: For at beskytte grundvand må der højst anvendes de i brugsanvisningen angivne maksimale doseringer pr. år. Der må endvidere i samme år ikke også anvendes andre produkter, der indeholder [aktivstoffet/aktivstofferne](#) på samme areal.

An alternative wording is:

To protect groundwater do not exceed the max application rate per year given in the instructions for use. Max X treatment(s) in total per area per year. Furthermore, in the same year, other products that contain active substance(s) must not also be used on the same area.

For at beskytte grundvand må der på samme areal højst anvendes de i brugsanvisningen angivne maksimale doseringer pr. år. Max. X behandling(er) i alt pr. areal pr. år. Der må endvidere i samme år ikke også anvendes andre produkter, der indeholder [aktivstoffet/aktivstofferne](#) på samme areal.

For use in crop(s) grown in or on the soil: To protect groundwater do not exceed the max application rate per year given in the instructions for use. Furthermore, in the same year, other products that contain active substance(s) must not also be used on the same area.

Ved anvendelse i [afgrøder](#) dyrket i eller på jorden: For at beskytte grundvand må der højst anvendes de i brugsanvisningen angivne maksimale doseringer pr. år. Der må endvidere i samme vækstår ikke også anvendes andre produkter, der indeholder [aktivstoffet/aktivstofferne](#) på samme areal.

For use in crop(s) max. X treated production cycle(s) per area per year. If relevant add: Treatment must only be carried out in growth stages BBCH xx-yy

Ved dyrkning af [afgrøder](#) max. X behandlet/ede hold pr. areal pr. år. Hvis relevant tilføjes: Der må kun behandles i vækststadier [BBCH xx-yy](#).

When treatment can only take place on closed ground surfaces (e.g. not pots placed on the ground/soil):

May only be used on closed production tables with recirculation or on closed ground surfaces with collection/recirculation.

Må kun anvendes på tætte borde med recirkulation eller på tæt bunds med opsamling/recirkulation.

In addition, the following RMMs may be required when relevant:

To protect groundwater, max. X treated production cycle(s) per area per year when cultivating ornamentals in pots placed on the ground/soil.

For at beskytte grundvand, må der max. [behandles X hold](#) pr. areal pr. år ved dyrkning af pryddplanter i potter på jorden.

For use in plants grown in pots on the ground without recirculation:

The pots must be placed close together or the foliage must completely cover the treated area.

Ved anvendelse i planter dyrket i potter på jorden uden recirkulering:

Potterne skal stå helt tæt (pottetæt kultur) eller kulturen skal dække arealet fuldstændigt (dækkende kultur).

When relocating treated plants outside to a container area/field without recirculation:

To protect groundwater do not relocate more than max X production cycle(s) per area per year when cultivating ornamentals and nursery plants.

Ved udflytning af behandlede planter til containerplads uden recirkulering:

For at beskytte grundvand må der max. udflyttes X behandlet/ede hold pr. areal pr. år ved dyrkning af prydplanter og planteskolekulturer.

To protect groundwater, treated plants must only be relocated to a container area with recirculation.

For at beskytte grundvand må behandlede planter kun udflyttes til containerplads med recirkulation.

Only relevant for use in strawberries:

The nozzles on the vertical spray boom must be set so that the spray liquid only is deposited on the plants in the row.

Dyserne på den vertikale sprøjteboom skal være indstillet således, at sprøjtevæsken kun afsættes på planterne i rækken.

When using a backpack sprayer, all the spray liquid must be deposited in the crop.

Ved brug af rygsprøjte skal al sprøjtevæsken afsættes i afgrøden.

Only relevant for drip irrigation, if drip irrigation may only be done on closed ground surfaces:

Drip irrigation must take place on closed production tables or closed ground surfaces such as concrete, minimum 2 layers of plastic or equivalent.

Drypvanding skal foregå på tætte borde eller på tæt belægning såsom beton, minimum 2 lag kraftig plastikfolie eller tilsvarende.

Or in special cases:

Drip irrigation must take place on closed production tables with recirculation or closed ground surfaces such as concrete, minimum 2 layers of plastic or equivalent with collection and recirculation of excess water.

Drypvanding skal foregå på tætte borde med recirkulation eller på tæt belægning såsom beton, minimum 2 lag kraftig plastikfolie eller tilsvarende med opsamling og recirkulation af overskydende vand

1.8 Evaporation

Vapour pressure is used to assess the volatility of substances, as higher vapour pressure will lead to a larger part of the substance in gaseous form at equilibrium (at a given temperature, typically 20°C).

When the vapour pressure is known, the volatility of substances can be classified according to the following categories⁸:

- | | |
|-----------------------------------|---|
| 1. Non-volatile / ikke-flygtigt: | Vapour pressure $< 5 \times 10^{-3}$ Pa |
| 2. Semi-volatile / semi-flygtigt: | Vapour pressure $\geq 5 \times 10^{-3}$ Pa & $< 10^{-2}$ Pa |
| 3. Volatile / flygtigt: | Vapour pressure $\geq 10^{-2}$ Pa |

⁸ <https://www2.mst.dk/udgiv/publikationer/2002/87-7972-331-4/html/bilo1.htm>

Substances for which significant evaporation is expected (vapour pressure $\geq 5 \times 10^{-3}$ Pa) and volatile substances cannot be approved for use in open greenhouses, unless they have a documented rapid breakdown in air, water and soil.

RMM based solely on the risk of leaching to groundwater over time due to condensation:

To protect groundwater do not apply more than X application(s) with active substance/s per greenhouse area per year.

For at beskytte grundvand må der max behandles X gange med aktivstof/fer pr. væksthuseareal pr. år.

Or

To protect groundwater do not apply more than X production cycle(s) with active substance/s per greenhouse area per year.

For at beskytte grundvand må der max behandles X hold med aktivstof/fer pr. væksthuseareal pr. år.

1.9 Non-target organisms (except bees)

Uses in open greenhouses are generally considered not to pose a risk to non-target organisms, as the open greenhouses are only open in the sense that exposure of the soil beneath them can occur. DEPA therefore does not expect that birds, mammals, arthropods, wild plants will be exposed.

Exposure to earthworms and macro- and microorganisms in soil can potentially occur. Most often, the risk assessment for field use can cover use in open greenhouses where the soil is exposed.

Exposure of aquatic organisms through leaching in drains is considered to be covered by the field use risk envelope in line with the risk of leaching to groundwater.

If this is not the case, then a risk assessment must be carried out, cf. the Danish assessment framework.

Only relevant for minor uses (Article 51 in Reg. (EU) 1107/2009):

DEPA will carry out an assessment based on the risk envelope, for the existing assessments of field uses for the PPP in relation to soil-living organisms. It is DEPA's experience that the applications applied for in open greenhouses often remain within the risk envelope of the open field uses in relation to non-target organisms.

1.10 Bees

The risk assessment for bees is carried out for bee-attractive plants which are to be moved to outdoor container areas/fields before resale or are expected to be sold in order to be planted outdoors, e.g. in gardens and on terraces. These will typically be ornamental plants. In addition, certain cuttings are treated and later planted outdoors. In this context, it should be noted that even if the pesticide is applied before flowering, systemic pesticides (pesticides absorbed by the plant) can subsequently be present in pollen and nectar of the flowers and thus expose bees.

The risk assessment for bees is based on the risk envelope for the assessments of outdoor uses for the PPP.

If movement of plants treated with pesticides outdoors e.g. to container areas/fields, an assessment of the need for a waiting period for the translocation must be performed.

Only relevant for bees: Relevant for amended use applications and minor uses (Article 51 in Reg. (EU) 1107/2009):

Text example if a PPP and its active substance(s) assessments are based on the old data requirements (Reg. (EU) no. 545/2011 and Reg. (EU) no. 544/2011, respectively). Please note that some PPPs on the new data requirements have been assessed in accordance with the old data requirements for bees, as there were no test guidelines or guidance document at the time of application other than for acute honey bee studies:

- "Note that an assessment has only been made for acute effects. This is because both the active substance and the PPP have been assessed on the basis of the old data requirements. Additionally, it has been assessed whether treated ornamental plants can be moved outdoors to a container site after treatment. The risk assessment for bees covers the relocation of treated ornamental plants to outdoor container areas. There is no restriction on the maximum number of treated cultures that may be moved outdoor per year in relation to the risk assessment for bees. However, DEPA sets a default grace period of 1 day before moving out."
- "At present, only acute effects have been assessed. This is because both the active substances and the PPP have been assessed on the basis of the old data requirements. Since both **Active substance A** and **Active substance B** are **growth regulators** with no known insecticide effect, it is not expected that chronic risk assessment will change the outcome of the risk assessment."

If it is a PPP for which it can be expected that a chronic risk assessment could change the outcome of the risk assessment (e.g. an insecticide), a weight-of-evidence assessment must be carried out, in order to set a waiting for relocation.

The following RMMs will be required when relevant:

To protect bees, treated flowering plants must be kept inside the closed greenhouse for a minimum of X day(s) after application.

For at beskytte bier må behandlede planter tidligst udflyttes X dag(e) efter sprøjtning.

When relocating treated plants outside to an outdoor container area/field:

To protect bees, do not relocate more than max X production cycle(s) per area per year.

Ved udflytning af behandlede planter til containerplads: For at beskytte bier må der max. udflyttes X behandlede hold pr. areal pr. år.

For systemic active substances one of the following two RMMs *may* be required:

To protect bees, treated plants must not be relocated outside.

For at beskytte bier må behandlede planter ikke udflyttes.

To protect bees, treated plants may only be relocated outside after flowering.

For at beskytte bier må behandlede planter først udflyttes efter afblomstring.

For non-systemic active substances one of the following two RMMs *may* be required:

To protect bees, plants treated during flowering may only be relocated outside after flowering.

For at beskytte bier må planter behandlet under blomstring først udflyttes efter afblomstring.

To protect bees, treated flowering plants must remain in the greenhouse until minimum X day(s) after last treatment

For at beskytte bier skal behandlede blomstrende planter forblive i væksthuse i minimum X dag(e) efter behandling

To protect bees, plants treated must stay indoors minimum X day(s) after treatment.
For at beskytte bier må behandlede planter tidligst udflyttes X dag(e) efter sprøjtning.

When relocating treated plants outside to a container area:

To protect groundwater and bees do not relocate more than max X production cycle(s) per area per year.

Ved udflytning af behandlede planter til containerplads: For at beskytte grundvand og bier må der max udflyttes X behandlet/ede hold pr. areal pr. år.