Point source pollution from open field crops: risks and solutions

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Pictures: PPO, DLV Plant, K. Meijaard, E. Bouma & TOPPS

Set up

- Importance of point emissions
- Sprayer: external contamination and cleaning
- Experiences bioremediation
- Pre-planting treatments
- Post harvest treatment and processing

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Aims of point source research

Initial goals:
- Prioritise emission pathways
- Develop, test and demonstrate solutions

Final goals
- Enlarging awareness
- Behavioural change

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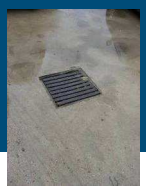
Emission routes: diffuse and point emission

- Diffuse:
  - Wash out through drainage systems
  - Spreading through air
    - Spray drift
    - Evaporation
  - Etc.

- Point emission:
  - Often linked to the farm yard
  - Discharge from greenhouses
  - Remnants, cleaning or process water with residues
  - Causes high peaks
  - UK, Germany, Sweden: 20-70% of total



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Contamination and cleaning of sprayers

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Filling and cleaning sprayers: surface water at risk?

- Where takes filling and cleaning place?

Questionnaires
- Arable farmers (81)
- Fruit growers (41)
- Flower bulb growers
- Tree growers

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Arable farming

- Filling: 42%: high risk for surface water
- Internal cleaning: 17% high risk situations
- External cleaning: 30% high risk situations
- Parking sprayer: 92% covered

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Fruit growers

Filling:

- 100% at farm yard
- 66%: no collection facilities
- 20% surface water within 10 m

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Fruit growers

- Internal cleaning
  - Frequent internal rinse: in orchard
- External cleaning:
  - 78% at farm yard
  - 24% uses collection facilities
  - 100-1000 L waste water per year

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External load on sprayer:

Literature scan (Van de Zande):

- Field sprayer: 0.1 – 0.5% of sprayed product
- Orchard sprayer (after Balsari, et al): 1% of sprayed product

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External load on sprayer: on farm measurements

Main goal = raise awareness:

- Maize (5 contract sprayers)
- Flower bulbs (contract sprayer and experimental farm)
- Strawberries (2 growers)
- Arable farmer

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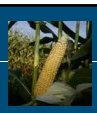
Contract sprayers maize



Cleaning after spraying 250 – 600 hectares maize:

- Terbutylazin highest load
- Standard exceedance when emitted to 'standard ditch'
- Terbutylazin 0.0001 – 0.002 % of sprayed product
- Nicosulfuron up to 0.1 % of sprayed product
- Max 9.4 g per active ingrediënt (average 0.6 g a.i.)

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Flowerbulbs

Contract sprayer: 6 weeks very intensive use

Contract sprayer:

- 54 active ingredients detected
- 12 substances too high in standard ditch (up to 1000 x EQS - deltamethrin)
- 0.01 – 0.1 g per problematic substances

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Strawberries

- Farm 1:
  - 46 a.i. detected
  - 20 a.i. too high in standard ditch (up to 1592 x EQS)
  - Max. 2.6 g a.i.
- Farm 2:
  Comparable observations

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External load: conclusions

Field sprayers

- Numerous actives substances on exteriour sprayer ('everything ever sprayed')
- Load after a longer period (weeks – months) of spraying << 0.5 %
- Load of problematic substances: 0.01 – 9 g /sprayer
- External cleaning water is always a potential risk for surface water

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External load: discussion

Why not 0.1 – 0.5% per active ingredient?

- Breakdown and rinse of (rain)
- Saturation of the sprayer surface during spraying (Michielsen, et al)
  - Active ingredient on sprayer surface up to 10x lower then extracted from absorbing collectors

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Filling and cleaning: current proposal for regulation (roughly):

- General rule: prevent damage to the environment
- Filling: protect the soil, collect waste (water)

- Internal cleaning:
  - Dilute and spray out over the crop that was sprayed

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Current proposal for regulation (roughly):

- External cleaning

Allowed to emit cleaning water to soil IF:

- in the field were the PPP's were applied

ór

- purified (specifications not yet defined – e.g. bioremidiation)

ór

- at the yard, in case of ≤ 2x cleaning per year

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Bioremediation of waste water & demonstration 2008-2011:

10 locations (on farm and on experimental farms)

- Phytobac©-type 3x
- Biofilter-type 7x

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Testing 'Phytobac' Vredepeel: maize herbicides

- April – Sept. 2008: influent spiked with herbicides
  - Bentazon, dimethenamid-P, terbutylazin, nicosulfuron, sulcotrion
- [effluent] versus [influent]:
  Reduction concentration ≥ 99,5%; bentazon 88%
- Breakdown: influent – effluent – substrate:
  - 90 - >99%; bentazon: 80%

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Testing 2008-2010: contract sprayer

Contract sprayer: 3- unit biofilter: 10-15 L / day
Results.... presented in Randwijk, tomorrow

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Contract sprayer: enlarged capacity

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Contract sprayer: enlarged capacity

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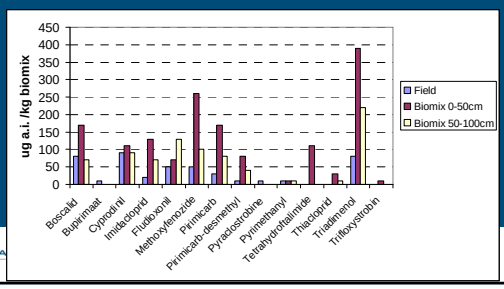
Results Fruit farm

- Risk of biomix disposal in the field?
- Concentration in biomix 2009 compared to field soil:



Overall results

- Effectiveness: mostly > 99%. Not always 100%
  - High percentage degradation in biomix
- High peaks of herbicides: no visible negative effects
- Evaporation is smaller then purification capacity
- Clogging of the system may be a risk for practical efficacy
  - Use dirt filters to prevent clogging
  - Realise (extra) aeration of the tubes between filter units, to ensure water flow

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Respons to demonstrations

- Growers & contract sprayer:
  - Simple and low cost = attractive
  - No problem with substrate and effluent?
  - Part of growers: preference for cleaning in the field
- Contract sprayers
  - Highly interested (more then average grower)
  - Need good facilities at the yard
  - Capacity?
- Bayer Crop Science: promotion of Phytobac

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Pre – planting application of PPP

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Bulb dipping before planting

carbendazim,
imidacloprid,
pyraclostrobin

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Transport of treated products: no leakage

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Farmer behaviour is also important...

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Contaminated boxes and crates

- Wash of by rain

- Loss of cleaning water

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Processing of harvested products

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Rinsing harvested product: leek, flower bulbs…

Reduce water volume and optimise recirculation

- First dry cleaning (leek)

- Enlarge water bassin (dirt settles at bottom: recirculation possible)

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Transport water from fruit sorting

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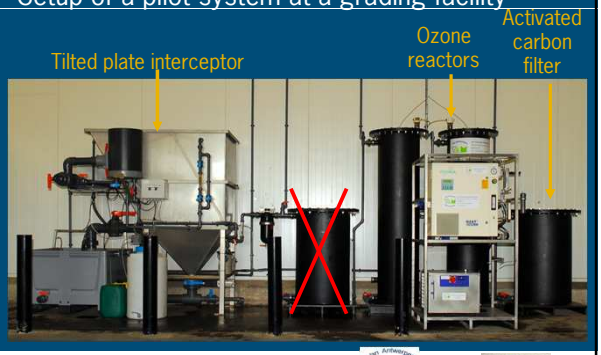
Setup of a pilot system at a grading facility



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Grontmij

Snapshot after 3 weeks of sorting and ozone

	Before tilted plate intercepter	After ozone
Fludioxonil	3.1	0.13
Tetrahydroftalimide (=metabolite captan)	210	6.7
Boscalid	36	34
Cyprodinil	0.15	0.032
DMST	0.057	0.016
Indoxacarb	0.29	0.31
Triadimenol	0.038	0.047
Propiconazool	29	27

Tilted plate + ozone effect: recycling from 1 week to 8-10 wks

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Snapshot after 3 weeks of sorting and ozone

	Before tilted plate intercepter	After ozone	After carbon
Fludioxonil	3.1	0.13	< 0.01
Tetrahydroftalimide (=metabolite captan)	210	6.7	0.63
Boscalid	36	34	5.2
Cyprodinil	0.15	0.032	0.0074
DMST	0.057	0.016	0.0098
Indoxacarb	0.29	0.31	0.024
Triadimenol	0.038	0.047	0.020
Propiconazool	29	27	4.9

Carbon effect: not sufficient yet
Improvement necessary

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Post harvest application of pesticides

- Flower bulbs (insects)
- Potatoes (growth inhibitor)
- Fruit (fungi)
- ...

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Emission route: condensation - cooling unit

- pirimifos-methyl
- Actellic: fogging against mites and thrips in bulb storage
- Condensation water is formed during cold storage (October - March)
- Concentration up to 275.000 x the EQS (0.002µg/ l)
- Hundreds (up to thousands) of liters of condensation water per day is possible

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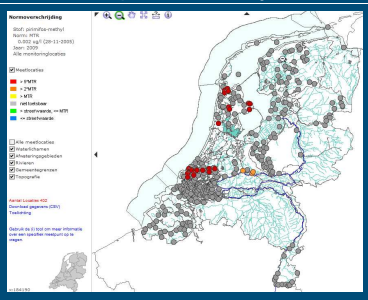
pirimifos-methyl



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Emissieroute pirimifos – methyl = condenswater

- Untill 2002: condensation
water often straight to surface water
- 2011: mostly emission to soil or collection with bulb dipping left overs

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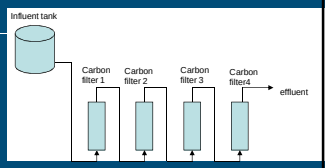
Carbon filtration
Laboratory test (Alterra)



- Clean water with pirimifos - methyl
- Result: each carbon filter binds 99.99%
- Four filters: effluent concentration is 3 * EQS
- Four filters needed to achieve concentration < EQS

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On-farm test

Dust filter integrated

5 carbon filters

- 3000 liter filtered (max. 20l/ hr)
- Influent: 158000 * EQS
- Effluent: 4 * EQS
- Carbon filters not saturated yet
- Reduction 99.997%
- Technical aspects need optimization

Filters from MAHLE Industrial Filtration BV

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Questions?

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