Dust drift emission during sowing

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Poisoned honey bees after sowing of maize in different European countries and the US due to large scale use of neonicotinoid treated seeds

Some reasons for effects on bees

- Pneumatic planters with air outlet at the top
- Bad seed treatment quality (dusty)
- High concentration of Neonics in dust
- Dry soil and windy weather
- Sowing at time of full flower and nectar flow of neighboring plants (e.g. oil seed rape)
- Special problems in regions with small fields (many bordering areas) and high frequency of maize and flowering crops in neighborhood
Seed quality and dust

- Amount, fraction size distribution and residue content of dust are relevant for exposure.
- All three may differ depending on crop type, dose rate, treatment recipe and treatment facility.
- Improving seed quality reduces dust (change of recipes), may also change % of a.s. in dust.
- An intensive cleaning of seeds before the coating process is essential.
- Quality of seed treatment facilities and use of adequate stickers / recipes are key factors to reduce dust emission.
- A certification of coating facilities plus quality checks of coated seeds are a good options in future.
Factors to be considered for risk evaluation of dust drift during sowing for bees and non-target organisms

- **Emission** of a.s. is influenced by:
  
  Seeding rate/ha x abrasion rate x % active substance in dust and dust particle size, driller type, drilling width, soil humidity, wind speed and direction

- **Exposure** influenced by:
  
  Emission + distance to emission, wind, stickiness of plant surface and structure, physical and chemical properties of a.s.

- **Effects** influenced by:
  
  Exposure + sensitivity and biology of organisms (e.g. presence, place, type and intensity of activity)
Scheme for dust exposure field experiments in the JKI
Suitable for wind from West and East

- drilling area (350 m long, 45 m wide)
- A: residues in dust collectors in open areas without crop
- neighboring bare soil (30-40 m long, 30 m wide)
- B: residues in neighboring crops and in dust collectors within a crop
- drilling area (350 m long, 45 m wide)
- tents with bee hives
Methods for sampling of dust

- Petri dishes with filter paper wetted with water/glycerol exposed on soil surface within crop and on bare soil in distance of 0.15 to 30 m from sowing
- Neighboring flowering oil seed rape or Sinapis wetted with water/glycerol in distances of 0.15 to 5 m from sowing
- Vertical gauze net wetted with water/glycerol in a distance of 3 m of sowing
- All samples collected directly after end of sowing (sampling for another 24 h never with relevant residues)
- Residues of neonicotinoids analysed after deep freezing of samples
Method: All drilling of maize using 90% drift reduction deflectors, wind 1-5 m/sec, flowering rape or *Sinapis* and open areas neighboring, 3 or 4 repl.
Maize sowing 2009, 2010, petri dishes in neighboring open area at soil level

22.1% clothianidin in fine dust
Heubach: dust 2.12 g / 100,000 seed
Heubach: a.s. 0.469 g / 100,000 seed
Dry soil

10.6% clothianidin in fine dust
Heubach: dust 0.86 g / 100,000 seed
Heubach: a.s. 0.091 g / 100,000 seed
Humid soil

2009

2010 minus about 80 %
Maize sowing 2011, 2012, petri dishes in neighboring open area at soil level

19.2% clothianidin in fine dust
Heubach: dust 0.45 g / seed sown/ha
Heubach: a.s. 0.086 g / seed sown/ha
dry soil

40.8% clothianidin in fine dust
Heubach: dust 0.10 g / seed sown/ha
Heubach: a.s. 0.041 g / seed sown/ha
dry soil
Maize sowing 2009 – 2012 (n = 5)
% of residues (1+3+5+10+20m = 100%) in different distances in petri dishes in neighboring open area
(1 data set of JKI-AT, Andreas Herbst)

% 40 35 30 25 20 15 10 5 0
distance m 1 3 5 10 20

ca. 20% of 1 m value
Maize sowing 2010: residues in neighboring oil seed rape compared to petri dishes

Residues in oil seed rape at 0.15 cm (0-30) distance in total >1 g / ha (no soil values analysed)
Clothianidin (g a.s./ha) in adjacent flowering OSR during maize drilling or flowering Sinapis during OSR drilling and in petri dishes in open areas (2009-2012)
in red → multiplication factor: petri dish to crop

Maize
- 2.5 – 1.4
- 4.4 – 1.7
- 2.3 – 1.5
- 3.4 – 1.9
- 1.6 – 1.1
- 3.2 – 1.1

OSR
Factor between deposition on vertical exposed nets and petri dishes in 3 m distance to the area drilled, both samplers in open areas.
Drift values of clothianidin treated seeds and abrasion quality of seeds in JKI experiments all planters pneumatic with air stream directed to soil

<table>
<thead>
<tr>
<th>crop and year of sowing</th>
<th>g.a.s. sown /ha in the experiment</th>
<th>Heubach dust in g a.i. sown / ha</th>
<th>Soil humidity %</th>
<th>g a.s./ ha (petri dishes, mean of 1-5 m distance)</th>
<th>g a.s./ ha (adjacent crop, mean of 1-5 m distance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>maize 2009</td>
<td>125</td>
<td>0.469</td>
<td>4.2</td>
<td>0.41</td>
<td>0.81</td>
</tr>
<tr>
<td>maize 2010</td>
<td>125</td>
<td>0.091</td>
<td>22.7</td>
<td>0.10</td>
<td>0.28</td>
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<td>maize 2011</td>
<td>50</td>
<td>0.086</td>
<td>16.8</td>
<td>0.15</td>
<td>0.27</td>
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<tr>
<td>maize 2012</td>
<td>16.7</td>
<td>0.041</td>
<td>11.5</td>
<td>0.022</td>
<td>0.051</td>
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<tr>
<td>rape 2009</td>
<td>46</td>
<td>not determined</td>
<td>12.5</td>
<td>0.058</td>
<td>0.082</td>
</tr>
<tr>
<td>rape 2011</td>
<td>36</td>
<td>0.025</td>
<td>14.4</td>
<td>0.021</td>
<td>0.033</td>
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<tr>
<td>barley 2012</td>
<td>46</td>
<td>0.086</td>
<td>7.1</td>
<td>0.024</td>
<td>not analysed yet</td>
</tr>
</tbody>
</table>
Conclusions

- Slowly falling residues with increasing distance to sowing
- Higher risk of drift at high Heubach values (in g a.s./ha)
- Deflectors at drillers reduce emission rates
- Petri dishes on bare soil represent exposure quite well for soil and aquatic systems
- Neighboring crops with higher residues near to the drilling area than in petri dishes in open areas
- Vegetation structure influences this filter effect
- Vertical gauze created worst case, but not sufficient data yet to validate this for different types of neighboring vegetation
- Filter capacity of neighboring plants and places of accumulated residues in plant parts needs more research
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