Role of spray application in IPM pome fruit crops

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Spray technique and IPM

- Spray technique influences:
  - Effective use of PPP:
    - Spray deposition in canopy
    - Biological efficacy
    - Residue on fruits
  - Environment:
    - Spray drift
    - Spray deposition on soil surface underneath trees
- Therefore spray technique of relevance for IPM
Spray drift in orchard spraying reference sprayer in full leaf stage apple
drift reducing technology in fruit growing
Apple 2011
View through outside 3 rows
Standard spray drift curves for three growth stages (BBCH) in apple in NL

- BBCH 0-60
- BBCH 61-73, 93-0
- BBCH 74-92
airborne spray drift for three growth stages (BBCH) in apples at 7.5 m from last tree row
### Classified drift reducing technology

**NL- orchard (3 m crop-free zone)**

<table>
<thead>
<tr>
<th>Drift reduction classes</th>
<th>Spray drift reducing technology in drift reduction class</th>
</tr>
</thead>
<tbody>
<tr>
<td>50%</td>
<td>50% drift reducing nozzle types + one-sided outside row; sensor sprayer + standard nozzles; reflection shield sprayer + standard nozzles; Wanner cross-flow + reflection shield + standard nozzles;</td>
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<tr>
<td>75%</td>
<td>75% drift reducing nozzle types+ one-sided outside row; tunnel sprayer + standard nozzles; KWH 3-row sprayer + standard nozzles;</td>
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</table>
### Classified drift reducing technology

**NL- orchard (3 m crop-free zone)**

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<thead>
<tr>
<th>Drift reduction classes</th>
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<tbody>
<tr>
<td><strong>90%</strong></td>
<td>90% drift reducing nozzle types + one-sided outside row; cross-flow + venturi nozzles + one-sided outside row; axial fan sprayer + venturi nozzles + one-sided outside row;</td>
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<tr>
<td><strong>95%</strong></td>
<td>90% drift reducing nozzle types + one-sided outside row + low air assistance; 95% drift reducing nozzle types + one-sided outside row + 4.5 m crop-free zone; Wanner cross-flow + reflection shield + venturi nozzles; KWH 3-row sprayer + 90% drift reducing nozzles; KWH 3-row sprayer + 90% drift reducing nozzles + variable air assistance; KWH 3-row sprayer + 90% drift reducing nozzles + reduced variable air assistance</td>
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</tbody>
</table>
New developments; Crop protection – fruit crops
dose related to development stage and biomass crop
Apple 2011 development
Ideas behind targeted application

- Reduce environmental load
- Keep a high efficacy
- Reduce risk of residue

- Apply only there where it is needed and with the amount adjusted for the crop canopy size and structure
Introduction of Canopy Density Spraying

- Sensing of the crop status / density
- Decision taking on the spray volume
- Actuating for the right application rate
- Based upon the knowledge of
  - Precispray 1999-2003
  - SensiSpray project within potatoes 2007-2008
  - Variable rate spraying in flower bulbs 2006-2009
  - CASA sprayer from EU project ISAFRUIT 2006-2010
Canopy Density Spraying (CDS) in apple and pear

- Laser ranger scanner measures distance and density of leaves
- Decision algorithms adjust number of nozzles spraying
- Varioselect nozzle bodies activate one or more nozzles
- Variable air amount depending on wind speed, wind direction, driving speed and direction
Canopy Density Spraying (CDS) in orchards

Automatic and real-time adjustment of an orchard sprayer based on measurement of canopy characteristics
Spray deposition measurements - tree

- Tracer BSF + Agral Gold
- Measurement on leaves and at collector on ground
- Following ISO -22522 (2007)
- Sampling every 10th leaf picked per sample zone
- Sampling 3 trees per object
Spray deposition measurements - ground

- Tracer BSF 0.7 g/L + Agral Gold
- Measurement on leaves and on collector on the soil

Wind direction

= sample tree
Results 2012 – deposition measurements

- Pear spindle

Reference 0.4 μl/cm²
Results 2012 – deposition measurements

- Deposition of CDS comparable to Munckhof reference = 0.40 µL/cm²
- Deposition of the CDS was lower than of the KWH crossflow sprayer (0.80 µL/cm²)
- Deposition of CDS was more homogeneous
- Spray volume reduction was 46% (BBCH 71)
Results 2014 – deposition measurement
apple spindle

- CDS-coarse
- Kwh-coarse
- CDS-fine
- Kwh-fine
- reference
Spray deposition on soil surface – single tree row spraying from both sides
Results 2014 – deposition measurements

- Deposition of CDS lower than reference = 0.60 µL/cm\(^2\)
- Deposition of the CDS was lower than the KWH crossflow sprayer (fine 0.50 µL/cm\(^2\) - coarse 0.70 µL/cm\(^2\) )
- Deposition of CDS was more homogeneous

- Forward speed 7.5 km/h to high for sensor resolution
- Open structure tree – adaptation of dose algorithm

- Very high spray deposition under treated tree row and paths alongside with coarse spray applications 35%-75%
- High spray deposition on downwind path for reference
Tested in practice by the grower - 2012

Sprayflow \( [L/min] \)
Results 2012 - CDS data

% spray time at 5 heights

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<thead>
<tr>
<th>Day in 2012</th>
<th>B-1</th>
<th>B-h</th>
<th>M-1</th>
<th>M-h</th>
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Results 2012 - CDS data

spray volume [L/ha] at 5 heights

Use reduction 49% - 65%
Adapted spray deposition from new developments e.g. multi-row sprayers

Verified spray deposition in trees show: Increase of 25%, and more even distribution over different parts of the tree (CV 40%-60%)

More attention for nozzle type and air assistance settings
Similar developments in other countries

- Spain – CAS, Dosavina (40%)
- Italy – revival of tunnel sprayers (30%)
- Germany – effect of sprayer air speed and forward speed
Conclusions and recommendations

- Spray technique:
  - Plays an important role in crop protection
  - Important to measure spray deposition
  - Need for re-evaluating dose-response algorithms
  - Is important for IPM
    - Reduces spray drift
    - Reduces PPP input
    - Reduces level of MRL

- Need for better understanding spray deposition process

- Need for a classification and certification system

  Use reduction + drift reduction = emission reduction
Thank you for your attention!

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Min. EZ
The future?