IDEFICS

a physical model of spray drift from boom sprayers in agriculture

HJ Holterman

Institute of Agricultural and Environmental Engineering (IMAG)
Wageningen, the Netherlands
Contents

• crop protection
• spray drift model
• calibration
• examples
• conclusion
Basic dilemma

- Efficient crop protection
- Prevent drift hazards

- Use small drops
- Avoid small drops
Quantifying spray drift

- **Experimental**
  - straightforward
  - direct use for regulations
  - laborious
  - expensive

- **Computational**
  - time-saving
  - cheap
  - throughout the year
  - verification required
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IMAG program for drift evaluation for field sprayers by computer simulation
IDEFICS model setup

Features:
- ballistic model (mixed 2D/3D)
- conventional boom sprayer
- cross wind

Results:
- downwind spray deposits
- airborne spray distribution
Essential parameters

- **field related**
  - crop height
  - ditch geometry

- **sprayer related**
  - height above crop
  - spray-free zone
  - nozzle selection
  - operational settings

- **environmental**
  - wind velocity
  - turbulence
  - temperature
  - humidity
Drop size distribution (PDA)
flat fan nozzle XR11004 @ 300kPa

fraction [%/µm]

drop size [µm]
Droplet diameter and distance of drift simulation

downwind distance [m]

initial drop diameter [µm]
Mathematics

• Newton’s second law of mechanics

\[ F = m \ a \]

gravity and drag force

• stepwise integrations

\[ a \rightarrow v \rightarrow x \]

• time step depends on rate of change of integration parameters
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Calibration experiments

Set-up
- single-nozzle sprayer
- cross wind
- cut grass

Variables
- height of sprayer boom
- nozzle type
- liquid pressure
- driving speed
- environmental parameters
Calibration
comparison of experiments and simulations (calibrated)
calculated deposits [%dose]
measured deposits [%dose]
Contents

• crop protection
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Downwind ground deposits
field experiments and simulation

deposits [%dose]

distance downwind from crop [m]
Reference setup for classification
standardized potato crop

Surface water at 2.125-3.125 m downwind from last nozzle
Spray drift to surface water
reference setup; various nozzles

drift (simulation) [%dose]

\[ y = 0.15x^{1.13} \]

XR11004, 300kPa
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Conclusion

**IDEFICS drift model:**
- can simulate spray drift from conventional boom sprayers
- is useful tool for drift hazard assessment
- is useful tool for nozzle classification based on drift hazard

**Developments:**
- extension for other nozzle types
- extension for air-assistant devices
- focus on airborne drift and evaporated drops