Adaptive Sprayer Technology
Organizational Alignment and Consensus Standards to Enable Change

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Liquid Spray Product Placement

Drift
- Pressure, Nozzle selection

Drift
- Variable conditions, Buffer needs

Boom Position

Distribution
- Chem Injection

Verify even coverage

Tank Agitation
Process for Considering Spray Drift in Ecological Risk Assessments

1. Evaluate importance of spray drift in exposure assessment
2. Describe spray drift’s contribution to exposure/risk
3. Spray drift IS a significant source of exposure/risk
   - Review labels for mandatory vs advisory language on:
     - Droplet size
     - Wind speed
     - Release height
     - Buffer zones
4. Use model estimates to describe the level of confidence in assessment conclusions, estimate buffer distance to mitigate potential risk
5. Use spray drift model to estimate deposition/exposure
6. No more spray drift work required

Poster: Encouraging the Use of Drift Reduction Technologies in the United States, 2015
Spray Drift in Risk Assessments

Spray drift is one route of exposure considered in OPP risk assessments

Spray drift is normally included in

- Terrestrial plant exposure estimates
- Aquatic exposure estimates
- Human Health: Resident and bystander exposure to spray drift
- Human drinking water exposure estimates
- Off-site terrestrial animal exposure estimates

Poster: Encouraging the Use of Drift Reduction Technologies in the United States, 2015
"Paradigm"

- a theory or a group of ideas about how something should be done, made, or thought about *(Meriam-Webster)*
  - Constrained by technology
  - Based on prevailing wisdom
  - May limit possibilities

Today's approach to pesticide risk assessment is a paradigm.
Fixed Risk Assessment

• All factors combined into one label – Runoff, aerosol, vapor, evaporated liquid
• Conservative parameters applied to all scenarios, receive same assessment
• Assumption of constant meteorological conditions
• Prescriptive sprayer configuration
• Constant or limited buffer zone options
Drift mitigation aligned with today's **fixed** risk assessment paradigm...

"Static" drift mitigation plan:

- Spray planning occurs in advance
- Minimal adaptation to weather factors
- Pre-configured sprayer
- Single set of installed nozzles
- Operator manually assess site-specific factors – i.e. weather, windbreaks, canopy, inversion factors
- Operator may spray multiple fields, many farms
A fixed risk assessment does not leverage the *Precision Ag and Data Management* capabilities of modern sprayers:

- Continual access to mobile data and cloud services,
- Data analytics,
- On-board data processing and task planning,
- Spray parameter closed loop control,
- Cautions and recommendations assistance to operator.
Flexible Risk Assessment

- Sensitive areas and species documented and updated
- Runoff, aerosol drift and volatilization addressed independently
- Each scenario receives tailored risk assessment
- Meteorological data available throughout task
- Buffer zone is adapted based on risk assessment
- Sprayer configuration is adapted as needed throughout the task
Drift mitigation possible with a flexible risk assessment paradigm:

"Dynamic" drift mitigation will use available state-of-the-art and precision ag technologies.

• Analyze data to assess potential hazards,
• Adjust configuration and parameters,
• Adjust task or path,
• Ensure optimum spray characteristic at the time of spray release.
Drift mitigation with an Adaptive Sprayer

- Spray task is continually evaluated for *OK to Spray*
- Spray parameters autonomously modified
- Variable buffers to optimize productive land use
- Variable application speed to optimize productivity
- Meteorology compliance
- Product as-applied documentation
- Sustainability metrics
Process for Considering Spray Drift in Ecological Risk Assessments

- Evaluate importance of spray drift in exposure assessment

  - Spray drift is NOT a significant source of exposure/risk
    - No more spray drift work required
  - Describe spray drift’s contribution to exposure/risk

  - Use model estimates to describe the level of confidence in assessment conclusions, estimate buffer distance to mitigate potential risk

  - Review labels for mandatory vs advisory language on:
    - Droplet size
    - Wind speed
    - Release height
    - Buffer zones

  - Spray drift IS a significant source of exposure/risk
    - Use spray drift model to estimate deposition/exposure

Poster: Encouraging the Use of Drift Reduction Technologies in the United States, 2015
Future Path

- Machine – Process control
- Machine – Data and Communications
- Sensitive Areas
- Drift Characterization
- Weather
- Product Label
- Mechanistic Physics Modeling
Machine – Process Control

- Management of spray parameters
- Boom height
- Boom section control
- Spray volume / spray rate
- Distance to sensitive area
  - GPS/GIS data
- Travel speed
Machine – Communication

- Machine operational data
  - Location
  - Sprayer configuration
  - Performance
  - Weather data
- Application Program Interface (API)
  - Data formatting
  - Program-to-program data share
  - Interoperability
Sensitive Areas

- Waterways, coastal land
- Endangered species
- Organic food production
- Non-compatible crops
- Populated areas
Drift Characterization

- Empirical models
  - Step changes across curves
  - Interpolation within curves
  - Nozzle
  - Droplet size class
  - Release height
  - Wind speed
  - Travel speed
Weather

- Macro
  - NOAA
- Regional
  - Mesonet (25 km)
- Local
  - Proprietary
  - Local ag networks
  - County Extension
  - Portable/mobile/on-board
Product Label

• Contents of label
  – Specific environmental, species restrictions
  – Approved tank mixes
  – Multiple rates
  – Buffer possibilities

• Electronic label access
  – Regulatory demands
  – CRISTAL – barcode and traceability
Mechanistic Physics Models

• Atmospheric Models
  – AgDRIFT, AGDISP®, Spray Advisor (USFS), CalPUF, PERFUM, SOFEA, FEMS, -- RegDISP/WTDISP

• EPA Aquatic Models
  – SWCC, PFAM, KABAM, SWAMP, SCIGROW, SWIMODEL, Tier I Rice Model, PRZM-GW

• EPA Terrestrial Models
  – SIP, STIR, T-REX, TIM, T-HERPS, TerrPlant
Consensus Standards

• ISO 5682 – Sprayer performance, section/nozzle control
• ISO/TS 11356 – Spray parameters
• SC6/WG21 – Drift measurement protocols and capabilities
  – ISO 22866 Field Measurement of Drift
  – ISO 22369-1 Drift classification -- Part 1: Classes
  – ISO 22369-2 Drift classification -- Part 2: Classification of field crop sprayers by field measurements
• CRISTAL – Barcode
• ASTM – Adjuvants
• NOAA/ASTM – Weather, frequency of update, confidence
• Agricultural Meteorology – e.g. Regional data array
Outreach and Communication

• In June, the Association of Equipment Manufacturers (AEM) and the Agricultural Retailers Association (ARA) organized an event at a farm in Maryland to demonstrate the many layers of technology and innovation manufacturers have implemented to reduce spray drift.

• AEM members John Deere, AGCO, Case IH, GVM and TeeJet brought a variety of equipment to the demonstration. AEM member Hardi also set up a display to explain their technology, and Helicopter Applicators, Inc. was onsite to demonstrate aerial application technology.

Outreach and Communication

https://www.youtube.com/watch?v=3F7sfl-KMV0
Roles and Characteristics of Organizations
Characteristics of organizations

Vision, Mission, Role, Core

Membership
• Open
• Closed

Funding
• Public
• Private

Authority
• Regulatory
• International
• National
• Informally aligned
ISO
International Organization for Standardization

ISO is an international standard-setting body composed of representatives from various national standards organizations.

Membership
• Open
• ISO has 162 national members

Funding
• Organizations that manage the specific projects or loan experts to participate in the technical work.
• Subscriptions from member bodies.
• Sale of standards.

Authority
• International consensus standards, Only given authority when adopted or referenced in other national regulation

Expertise
• All topics, all disciplines
ASABE
American Society of Agricultural and Biological Engineers

An ANSI accredited SDO and an educational / scientific organization dedicated to the advancement of engineering applicable to agricultural, food, and biological systems.

Membership
• Open
• ASABE comprises 8,000 members in more than 100 countries.

Funding
• Direct organizational support
• Subscriptions from organizations.
• Sale of standards.

Authority
• North America consensus standards, no legal authority unless referenced in US or Canadian regulation

Expertise
• Agriculture, all aspects of production and supporting systems
AgGateway

Vision: Become the recognized North American source for enabling the use of information and communication technologies for agriculture.

Mission: Promote, enable and expand eBusiness in eAgriculture.

Membership
• Open; over 240 members, primarily businesses.
• Other organizations typically join as Associate members
• There is a category for individual memberships.

Funding
• Member dues, project fees, and service subscriptions, dependent on volume of business.

Authority
• De facto: Implementation by stakeholders.

Expertise
• Supply chain and field operations business processes
Role
• Direct and prioritize standards development effort
• Support standards adoption
• Fund prototyping and tests

Membership
• Open to industry
• Equipment, hardware and FMIS manufacturers

Funding
• Service fee
• No cost to universities

Authority
• Supportive of consensus standards,

Expertise
• Electronics and connectivity
AEM
Association of Equipment Manufacturers

Mission Statement
AEM will serve equipment manufacturers operating in North America to create a strong voice for its members and the industries it represents in the global marketplace by delivering superior services in public policy, market information, trade shows, technical and safety services, education and market support.

Membership
• Equipment manufacturers

Funding
• Member dues, tradeshows

Authority
• Influence public policy, Promote use of consensus standards

Expertise
• Agricultural, construction, forestry, mining and utility industries
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ASABE / CSA / ISO
- National & International
- Committees alignment
- Voting differences
In-Scope:  Including joint TC or SC development activities.


ISO TC 23/SC 6 Standards

- Equipment / Components
  - Pumps
  - Hoses
  - Flow Control

- Product Placement
  - Drift
  - Deposit
  - Consistency
  - Integrity
  - Droplet characteristics

- Chassis
  - Safety
  - Access
  - Stability

- Controls, Systems
  - Traceability
  - Stability
  - Sensing
  - Injection
  - Rate control
  - Nozzle & boom control

- BMP

Electronics / Controls
- SC 19
- AEF
- AgGateway

Products Applied
- CropLife
- ECPA

Information / Manuals
- AEM
- Extension
- Worker Training

Worker Protection
- OSHA

Environmental
- EPA

Extension
- ASE-16
- BMP

In-Scope: Including joint TC or SC development activities.
American National Standards Institute [ANSI]

American Society of Agricultural and Biological Engineers [ASABE]

MS-23 and ISO TAG’s

MS-54 Prec’n Ag

MS-60 Aerial App’n

ASE-134 and ISO TAG Fertilizer

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Adaptive Sprayer

ISO 5682 – Sprayer performance
ISO/TS 11356 – Spray parameters
ISO 11783-10 – ISOBUS communication
NOAA – Weather
ASTM – Adjuvants
AgGateway – ‘OK to Spray’
AgGateway – Regulatory Reporting
Questions?

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