Supporting Spray Drones for CP Applications: Overview of Industry Initiatives to Address Regulatory Requirements

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ASSOCIATION OF AMERICAN PESTICIDE CONTROL OFFICIALS

Drones by the numbers…

As of June 2024, drones have treated over **1 billion acres** of land worldwide. There are currently over 300,000 agriculture drones working worldwide. **3.7 million acres** were sprayed by drone in 2023, across 41 states and 50 crops.
https://www.ndsu.edu/agriculture/sites/default/files/2025-02/Pesticide%20Applications%20the%20Drone%20Way.pdf

The global agriculture drone market size was valued at USD 4.98 billion in 2023. The market is projected to grow from USD 6.10 billion in 2024 to USD 23.78 billion by 2032
https://www.fortunebusinessinsights.com/agriculture-drones-market-102589

2025 U.S. Agricultural Spray Drone Industry Survey (American Spray Drone Coalition)
The U.S. agricultural spray drone industry continued its aggressive expansion in 2025, with total treated acreage reaching over 16.4 million acres—a 58.7% increase year-over-year (YoY).

This growth was driven almost entirely by a 58.3% increase in the number of approved Part 137 UAS operators (to 1,710), rather than improvements in operational efficiency.

2021: FAA reported 40 approved Part 137 Waivers for Ag Drones
2025: FAA-reported count of 1,710 approved Part 137 UAS operators
https://americanspraydronecoalition.com/wp-content/uploads/2026/01/2025-ASDC-Impact-Survey-Results.pdf

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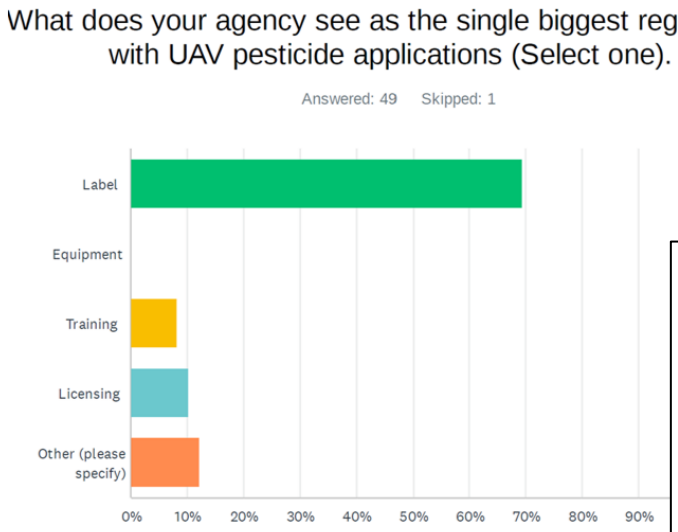
AAPCO Survey – User Feedback

State Regulatory Issues?



Why is this an Issue?

No drone specific label language to follow.

Default to aerial, doesn't really work, restrictive to conventional types.

- Causes applicator guesswork
- Word of mouth
- Following non-researched based settings. #SocialMedia

Liability on the applicator to confirm label useability.

APPLICATION EQUIPMENT

7[a] APPLICATION EQUIPMENT AND TECHNIQUES

Do not apply this product through any type of irrigation system.

This product may be applied with the following application equipment:

Aerial—Fixed Wing and Helicopter

Ground Broadcast Spray—Boom or boomless systems, pull-type sprayer, floaters, pick-up sprayers, spray coupes and other ground broadcast equipment.

Hand-Held or High-Volume Spray Equipment—Knapsack and back-pack sprayers, pump-up pressure sprayers, handguns, handwands, mistblowers*, lances and other hand-held and motorized spray equipment used to direct the spray onto weed foliage.

*This product is not registered in California or Arizona for use in mist-blowers.

Selective Equipment—Recirculating sprayers, shielded and hooded sprayers, wiper applicators and sponge bars.

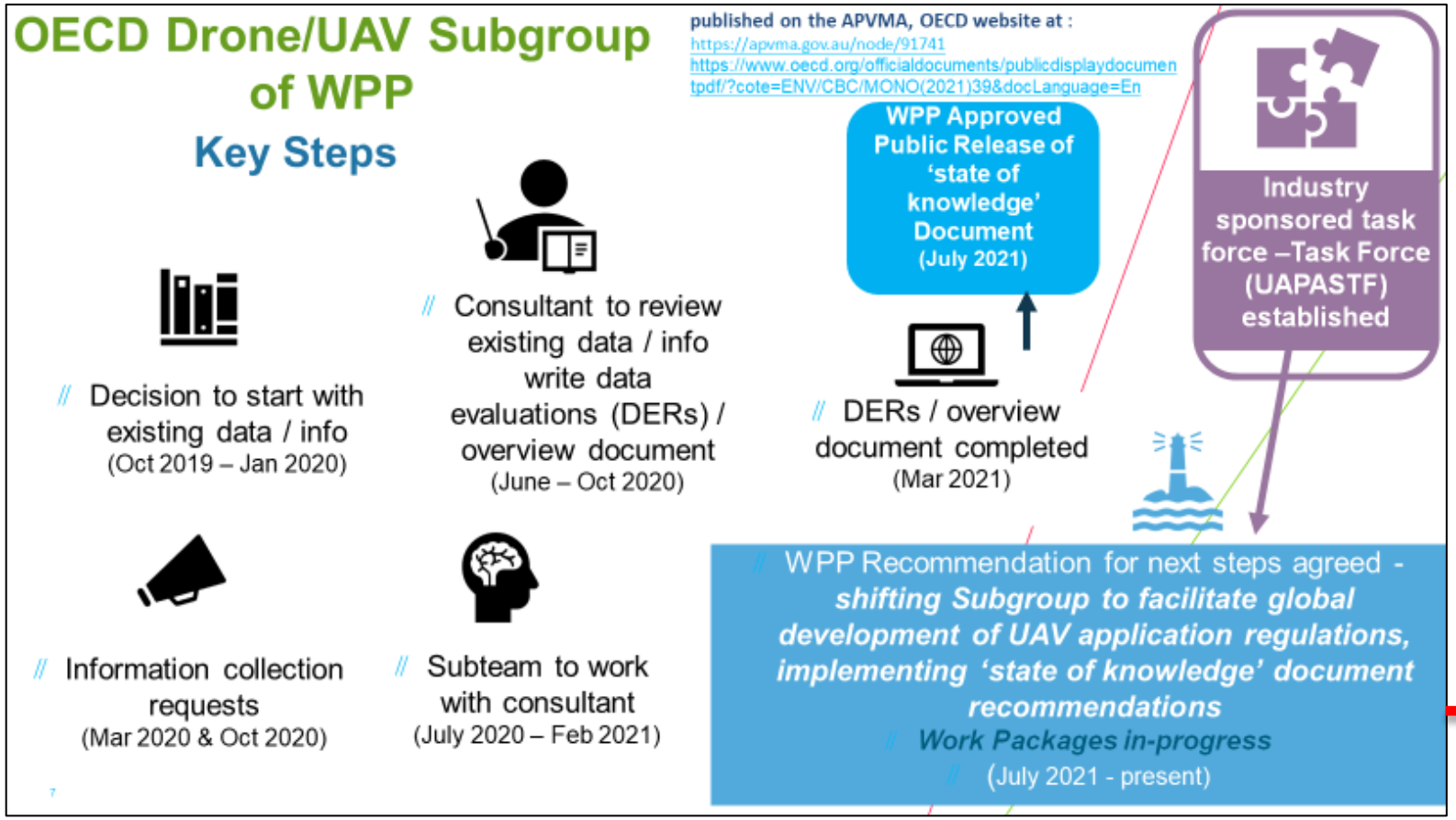
Injection Systems—Aerial or ground injection sprayers.

What is being done?

- **Unmanned Aerial Pesticide Application System Task Force (UAPASTF)**
  - Generating and submitting regulatory data to EPA

- **AAPCO and CLA Drone Labeling Workshop**
  - 3-part virtual series bringing together drone and pesticide stakeholders
  - Explore the future of drones in pesticide applications and the critical role of labels & labeling.
  - Goal is to come to a consensus on common drone label language

OECD WPP Drone Subgroup – est. 2019



OECD *State of the Knowledge* Work Packages
Drift/Off-site Movement
Operator Exposure
Crop Residue
Best Practices

UAPASTF

Unmanned Aerial Pesticide Application System Task Force Established 2021

- **UAPASTF formed in response to the OECD WPP Drone/UASS Subgroup recommendations—State of the Knowledge Report (2021)**
- **Based in the US - but global in its work / focus**
- **UAPASTF global core mission: supply UAV-based regulatory data to be used in conducting human and environmental risk assessments to support UAV regulatory approvals**

GLP Drift Trials & Models	Worker Exposure
Crop Residue	Best Practices

- **UAPASTF interacts with OECD Drone/UASS Subgroup of WPP, regulatory agencies, CropLife, EUPAF & other stakeholders to develop & provide information / data**
  - **Established and seeking collaborative and confidentiality agreements with UAV-application companies and experts (e.g., additional UAV-application companies in other world areas, UAV manufacturers)**

UAPASTF

Member Company	*Administrative Committee*	*Technical Committee*
BASF Corporation	Rebecca Willis	**Frank Donaldson (Chair)**
Bayer CropScience LP	**Sarah Hovinga (Vice-Chair)**	Jane Tang
Corteva Agriscience	**Travis Bui (Chair)**	Rajeev Sinha (Vice-Chair)
Gharda Chemicals Intl	**Ram Seethapathi (Treasurer)**	Frank Sobotka
Gowan Company LLC	Raymond Layton	Jason A. McDonald
FMC Corporation	Hector Portillo	Roberto Barbosa
NuFarm Americas Inc.	Patti Turner	Tyler Gullen
Syngenta Crop Protection LLC	Jonathan Nicholas	Jo Davies
Valent U.S.A. LLC	Leslie Garcia	Frank Carey
Task force managers	*Rhonda Bichsel*	*Eric Bruce*

Visit Our Website
www.UAPASTF.com

Global Regulatory Data Needs – "State of the Knowledge"

Environmental Exposure & Risk Assessments

- Understand Spray Drift/Off-site Movement
- Development of Empirical and Mechanistic Models

Operator Exposure

- Qualitative "Job Steps" Survey
- Evaluation of Current NDE Models

Best Practices

- Pesticide application requires expertise and stewardship—especially with new technologies
- September 2024 – v1.0 Released

Crop Residue

- Are crop residues from UAV applications equivalent when compared to conventional applications?
- Connection to Agriculture and AgriFood Canada Residue Program

Agriculture & Agri-Food Canada

- Martin Trudeau, AAFC
- Jessica Stoeckli, AAFC

Agriculture and Agri-Food Canada

UAPASTF

Field Drift Studies – Data Generation Plan

Location	Timing
USA (non GLP) (Robstown, Texas)	February 2023
Canada (GLP) (Saint-Jean-Sur-Richelieu, Quebec)	May 2023
Brazil #1 (GLP) (Santa Helena de Goiás, Goiás)	September 2023
Hungary (GLP) (Bugac)	October 2023
Spain (GLP) (Oropesa)	November 2023
USA (GLP) (Robstown, Texas)	December 2023
Brazil #2 (GLP) (Castro, Parana)	March 2024
Australia (GLP) (Clifton, Queensland)	April 2024
South Africa #1 (GLP) (Delmas, Mpumalanga)	September 2024
South Africa #2 (GLP) Hertzogville, Free State	September 2024

Globally focused Good Laboratory Practice (GLP) program

- Repeatable experiment to compare drift behavior across locations
- Single CRO & UAV pilot/consultant at each location
- DJI T30 used as benchmark UAV; hydraulic nozzles compared to ground
- Each UAV treatment followed by a ground sprayer (with same spray quality—fine/medium/coarse)
- In-line pressure gauges to confirm spray quality
- Bare ground apps; Release height: 3m (UAV), 0.5m (ground)
- UAV spray pattern was measured for the UAV, release height, nozzle, speed, and environmental conditions
- **Based on "Recommendations for Conducting UAV Field Drift Trials – Proposed Field Study Protocol Guidance", available at https://uapastf.com**

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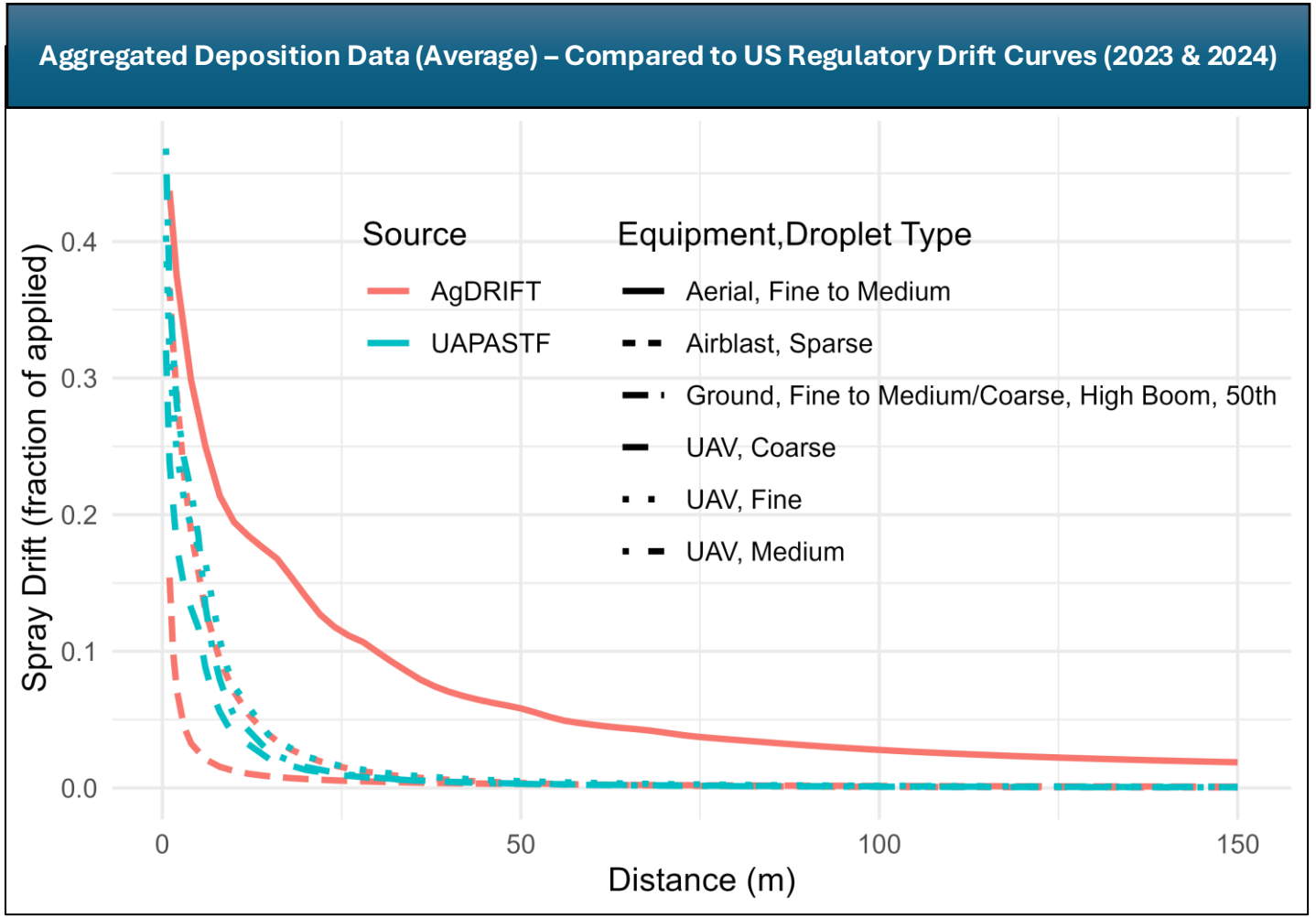
UAPASTF Spray Drift Trials – 2023 & 2024

- **UASS deposition results**
  - Follow expected trend by droplet size
  - 90% ground deposition within 16m
    - 99% ground deposition observed by 32m
  - Data fall between regulatory drift curves for ground and aerial applications

- **Data Submissions Complete!**
  - **2023 Data**: Submitted June 2024
  - **2024 Data**: Submitted February 2026
  - Includes Non-GLP Summary Drift Analysis

- **Modeling**
  - **Empirical Curves** using UAPASTF + Literature Database
  - **Mechanistic Models** – discussions on-going

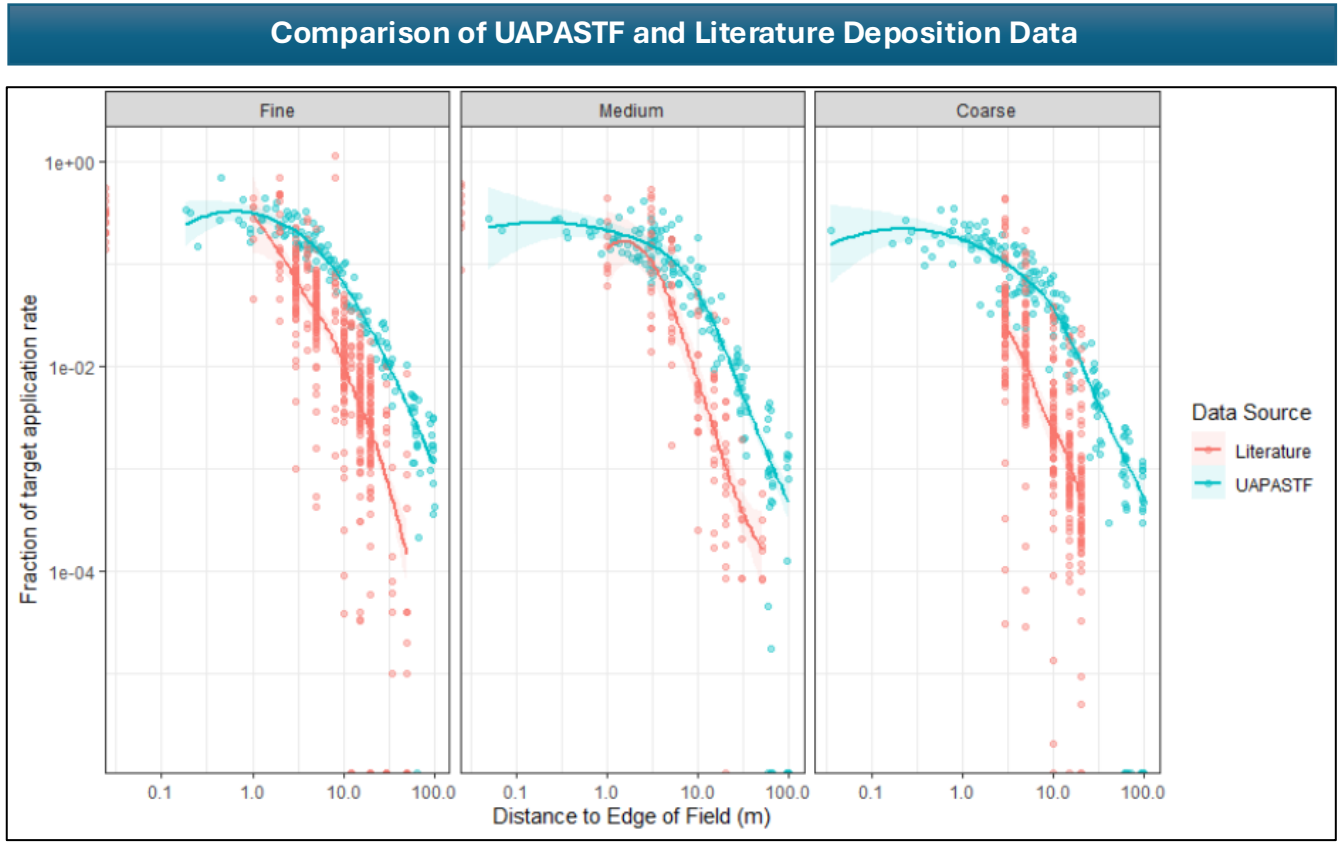


Comparison to Published Literature

- **Collaboration with Dr. Jane Bonds & CropLife America**
  - Database was initially built with data from publications deemed to be relevant and reliable for regulatory purposes
  - Includes 6 studies from prominent global drift researchers
  - These literature studies covered a range of UAV types, application/environmental conditions, presence / absence of crop (and crop type), and spray particle size distribution.

- **Results**
  - Deposition data is within an order of magnitude—despite substantial differences in study parameters.

  - This high-level analysis indicates the UAPASTF dataset tends to be higher than the published literature.



Bonds Publication:

Non-Dietary Exposure - Survey

GOAL 1: collect qualitative information on job step distribution for operators (mixer/loader/applicator)

- A data gathering exercise for job-step or operational practices, including mixing and loading scenarios, would help to both better understand the potential exposure pathways and develop or adapt existing exposure scenarios in order to make them more representative of working practices with drones.

GOAL 2: collect quantitative information on job steps and applications

- It may be possible to use established exposure models and approaches to predict the levels of operator exposure resulting from the use of drones.
- The most relevant quantitative information related to the parameters that drive the current risk assessment should be collected
  - Formulations handled
  - Area treated per Day
  - Volume sprayed per unit area
  - Equipment and techniques used to mix, load, clean, etc

Status

March 2025 – Test Survey Conducted

- Purpose: test various applicator exposure concepts and questions on people using unmanned aerial spraying systems in preparation for a larger global survey
- 147 Participants with 72 usable responses

October 2025 – US Main Survey Initiated (n = 250)

- 1-on-1 phone interviews completed
- Data analysis on-going

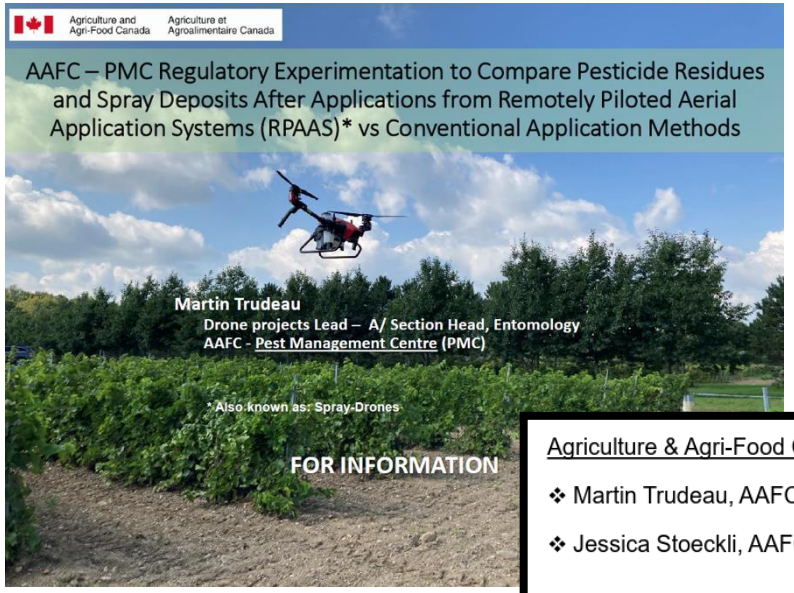
Current & Future Collaboration Efforts

- Compare results to concurrent UK CRD survey in EU & APAC
- Submit Survey to regulators—Summer 2026
- Additional regional surveys TBD

Residue Data for UAV Crop Applications

- **Are crop residues from UAV applications equivalent when compared to conventional applications?**
  - A multidisciplinary working group (WG) was formed
  - A side-by-side GLP comparative study of chemical residues levels from drone and conventional (ground) applications:
    - Multiple UAV platforms
    - 4 crop types (large field, small field, orchard & trellis)
    - Increased application rates above labeled rates and reduced PHI to ensure quantifiable residues
    - PMC conducted field trials at 7 locations in Canada

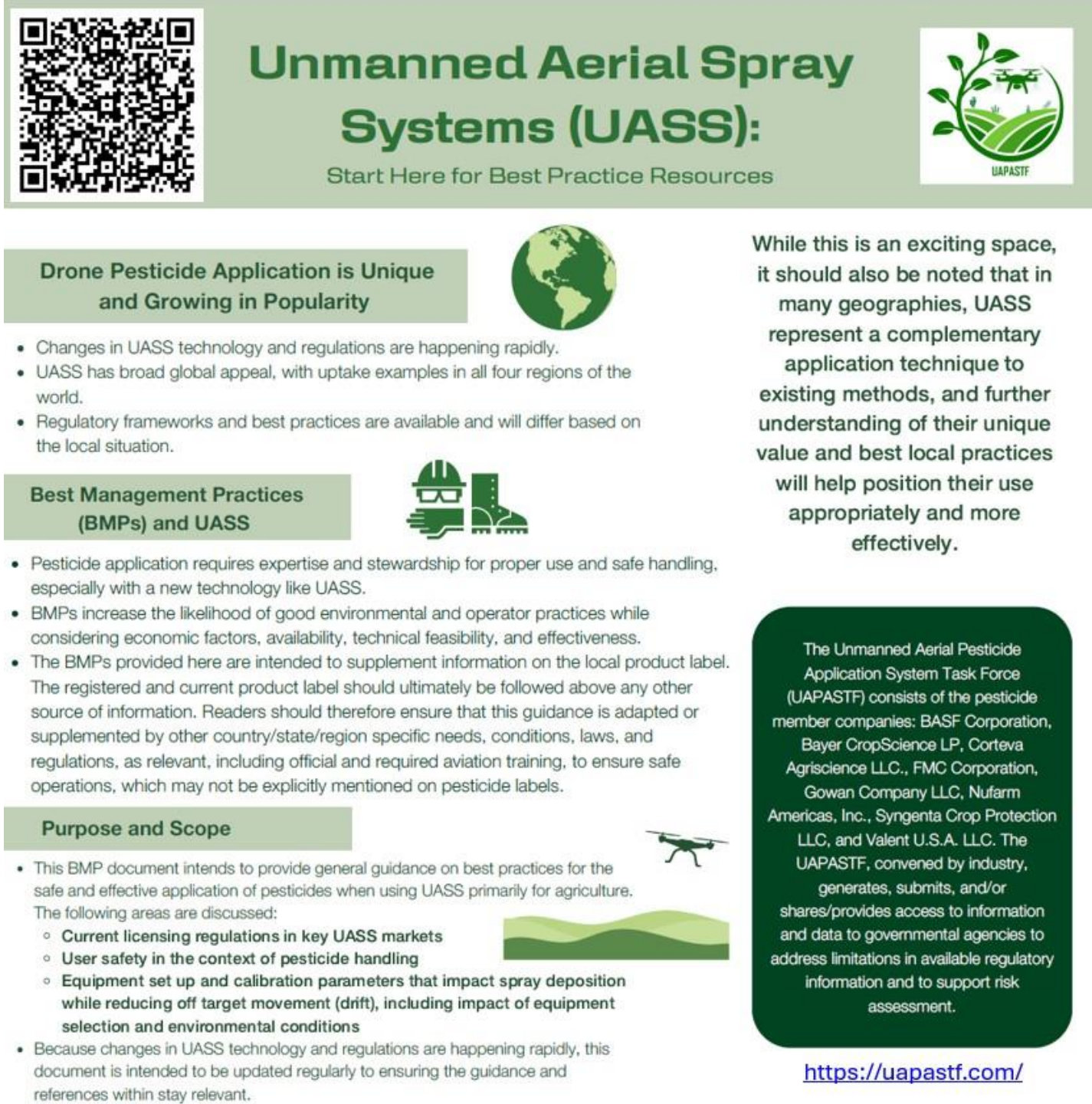
- **Initial results show that residues from drone application are equivalent (or no worse) than boom applications.**
  - Residues for side-by-side drone applications were not statistically different.



Working Group Membership	
AAFC – Strategic Policy Branch	Bayer
AAFC – Pest Management Center	Syngenta
HC – Pest Management Regulatory Agency	Strongfield Environmental Solutions
Transport Canada	Precision AI
TBS – Center for Regulatory Innovation	Protein Industries Canada
OMAFRA	Aerial Evolution Canada

UAPASTF BMP Considerations

- Pesticide application requires expertise and stewardship—especially with new technologies
- BMPs increase the likelihood of good environmental and occupational practices
- Not our intention to make this a standard (for example ASAE) but the UAPASTF BMPs could be utilized in works towards standards
- Can be used as guide to expand on local BMPs
- The registered and current product label should ultimately be followed above any other source of information
- Input sought and received from key external experts including: academics, government entities, OECD & CropLife, application specialists and drone manufacturers
- This document is not endorsed or approved by any other organization besides the UAPASTF



Unmanned Aerial Spray Systems (UASS):

Start Here for Best Practice Resources

UAPASTF

Drone Pesticide Application is Unique and Growing in Popularity

- Changes in UASS technology and regulations are happening rapidly.
- UASS has broad global appeal, with uptake examples in all four regions of the world.
- Regulatory frameworks and best practices are available and will differ based on the local situation.

Best Management Practices (BMPs) and UASS

- Pesticide application requires expertise and stewardship for proper use and safe handling, especially with a new technology like UASS.
- BMPs increase the likelihood of good environmental and operator practices while considering economic factors, availability, technical feasibility, and effectiveness.
- The BMPs provided here are intended to supplement information on the local product label. The registered and current product label should ultimately be followed above any other source of information. Readers should therefore ensure that this guidance is adapted or supplemented by other country/state/region specific needs, conditions, laws, and regulations, as relevant, including official and required aviation training, to ensure safe operations, which may not be explicitly mentioned on pesticide labels.

Purpose and Scope

- This BMP document intends to provide general guidance on best practices for the safe and effective application of pesticides when using UASS primarily for agriculture. The following areas are discussed:
  - **Current licensing regulations in key UASS markets**
  - **User safety in the context of pesticide handling**
  - **Equipment set up and calibration parameters that impact spray deposition while reducing off target movement (drift), including impact of equipment selection and environmental conditions**
- Because changes in UASS technology and regulations are happening rapidly, this document is intended to be updated regularly to ensuring the guidance and references within stay relevant.

While this is an exciting space, it should also be noted that in many geographies, UASS represent a complementary application technique to existing methods, and further understanding of their unique value and best local practices will help position their use appropriately and more effectively.

The Unmanned Aerial Pesticide Application System Task Force (UAPASTF) consists of the pesticide member companies: BASF Corporation, Bayer CropScience LP, Corteva Agriscience LLC., FMC Corporation, Gowan Company LLC, Nufarm Americas, Inc., Syngenta Crop Protection LLC, and Valent U.S.A. LLC. The UAPASTF, convened by industry, generates, submits, and/or shares/provides access to information and data to governmental agencies to address limitations in available regulatory information and to support risk assessment.

https://uapastf.com/

Next Steps

- **Regulatory Submissions – Complete!**
  - 2023 & 2024 Field Trial Data
  - EEE Summary Report
- **Building an off-site movement database**
  - Develop empirical / mechanistic exposure models
- **Non-Dietary Exposure Survey**
  - Complete data analysis
  - Develop additional surveys outside US
- **Potential Additional Regulatory Considerations**
  - UAV Platforms
  - Nozzle configurations
  - Labeling

UAPASTF alignment with the work of the OECD WPP Drone/UASS Subgroup critical to success

https://www.oecd.org/content/dam/oecd/en/topics/policy-issues/chemical-safety-and-biosafety/progress-report-june-2025.pdf

Drones / Uncrewed Aerial Spray Systems (UASS)

The **Drone/UASS Subgroup** (Lead UK) oversees a programme of work to set out a framework that will enable regulatory authorities to assess the risks associated with applying pesticides using drone technology, and to provide guidance to an industry Task Force and other Unmanned Aerial Vehicle (UAV) groups, as appropriate, on addressing the recommendations to fill data gaps included in the 2021 ***OECD Report on the State of the Knowledge – Literature Review on Unmanned Aerial Spray Systems in Agriculture***. See the work of the Drone/UASS Subgroup "In Focus" below.

IN FOCUS: SUPPORTING THE ASSESSMENT OF RISKS ASSOCIATED WITH DRONE / UNCREWED AERIAL SPRAY SYSTEMS APPLICATIONS OF PESTICIDES

To allow **a focused and more harmonised international approach to deliver potential efficiencies for governments and industries**, it is important that the regulatory, industry, research and other communities be aware of the recent and on-going efforts which are contributing to the developing evidence base to support the assessment of risks associated with Uncrewed Aerial Spray Systems (UASS)[1] applications of pesticides.

The **OECD Drones/UASS Subgroup (OECD Drone Subgroup)** is providing advice to a Task Force convened by industry (Unmanned Aerial Pesticide Application System Task Force [UAPASTF]), and other relevant groups, to address limitations in available regulatory information and to support risk assessment in relevant governmental agencies, as recommended in the 2021 ***OECD Report on the State of the Knowledge Literature - Review on Unmanned Aerial Spray Systems in Agriculture***[2]. Though the information, databases and models being generated by the UAPASTF and other relevant entities will not be OECD products, work undertaken by the UAPASTF is being conducted under specific guiding principles, processes, and criteria[3] endorsed by the Working Party on Pesticides, and the OECD Subgroup intends to release, **in 2025 and/or 2026, a Summary Report(s) of its compiled references and views on data, information and tools being generated**.

The OECD Drone Subgroup is preparing to review, in 2025/2026, UAPASTF developed **empirical spray drift curves** to help estimate off-target exposure from drone applications, informed by the UAPASTF **database of spray drift and deposition empirical data for regression analysis**. The database contains (1) "mined" data from peer-reviewed publications, (2) potentially new data from research activities of other registrants and researchers, and (3) is being supplemented with data resulting from a significant UAPASTF GLP field-testing programme of off-site movement of pesticides applied by drones performed in seven countries on five continents in 2023 and 2024 according to a predefined protocol. The UAPASTF is currently submitting full study reports to specific national regulatory agencies as part of the pesticide product registration process.

The Drone Subgroup has provided feedback to the UAPASTF on **recommendations for conducting unmanned aerial vehicle (UAV) field drift trials** and on UAPASTF **guidance for the safe and effective application of pesticides using UASS** and is providing advice on work to refine the understanding of the **influence of drone design on the risk of pesticides applied** using the technology and on **exposures that result from handling and filling operations**. It is staying informed of activities to improve the spraying systems of drones to provide an appropriate application quality and to minimise environmental risks.

The Drone Subgroup is also staying informed of initiatives to develop a **mechanistic model for predicting spray deposition and drift**. The development of a useable publicly available mechanistic model for use by regulatory agencies for the assessment of risks from drone spray drift is a longer-term objective of the Drone Subgroup.

The United Kingdom is leading this project. For more information contact Jane RICHARDSON and Sally DE MARCELLUS.

[1] UAV, unmanned aerial vehicle, refers to the "drone" aircraft. UASS, uncrewed aerial spray system, is used to indicate a drone with a spray system. UASS is used to be consistent with the International Organization for Standardization (ISO) technical committee using "UASS". However, the ISO uses "Unmanned Aerial Spray System" and the OECD Drone/UASS Subgroup chose in 2022 to use "Uncrewed Aerial Spray System".

[2] OECD (2021), Report on the State of the Knowledge – Literature Review on Unmanned Aerial Spray Systems in Agriculture, Series on Pesticides and Biocides, OECD Publishing, Paris, https://doi.org/10.1787/9240f8eb-en.

[3] Guiding principles, processes, and criteria for the work of the OECD Drone/UASS Subgroup of the Working Party on Pesticides [ENV/CBC/AVRPR(2024)8/FINAL].

CLA Drones Working Group

The Working Group's mission is to evaluate existing data used to assess or generated by crewed aerial and/or traditional pesticide application methods within a regulatory context to identify equivalencies and gaps for UASS/drone applications

Key Deliverables:

- Developed white paper entitled: **UASS Pesticide Application: Benefits and Fit into the Current Regulatory Framework (Link)**

- Interim drift curve project with Dr. Jane Bonds **https://doi.org/10.13031/ja.15646**

- **CropLife America Drones Working Group's Information Hub (Link)**

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CLA-AAPCO Drone Labeling Workshop

Agenda, Workshop Part 1

- Welcome/Objective of the workshop - 10 min Nathan Davis (Indiana Office of State Chemist)
- Speaker Introductions (Brief: Name, Entity[ies] represented/Experience in Drone Space) - 15 min, moderated by Rebecca Willis (BASF)
- Drone use overview: Need for application drones, Technology status, Progress, Regulatory Gaps (What is working label-wise, What is not working). Applicator groups sharing job steps/workflow at a high-level for drone applications.
  - Non-Ag and Aquatics - 20 min Briana Layfield (AgBee)
  - Ag - 15 min Alex Ryan (AgriSpray Drones)
  - Mosquito - 15 min Joel Buettner (Placer County)
- Combined Q&A - 20 min
- Current status of the "open" regulatory topics: Drift, Operator Exposure, Crop Residues, Label Language -
  - Global Pesticide Registrant Perspective 10 min Travis Bui (Corteva)
  - USA Pesticide Registrant Perspective 10 min Katie Stump (CLA)
- Current pathways for labels/labeling and considerations for drones/UASS
  - State needs - 15 min Mark Carter/Adam Shanks (Purdue)
- Clarifying questions, wrap-up, next steps - 30 min Nandita Chowdhury (Clarke) and Sarah Hovinga (Bayer)

Let us know your interest in continuing this work with us (speakers too!)

https://www.surveymonkey.com/r/K5H58Z7

Workshop Part 2: TBD Q1/Q2 of 2026

- Break-out Workshop on initial language: not expected to be finalized at this 1st workshop. This is intended to be a for participants to work on draft language, take back to consider within their own entities, and then come back to the 3rd virtual workshop with feedback/suggestions
  - Breaking out into teams: Work on real labels directly and work on Priority 1/Low-hanging Fruit: i.e., Products with aerial on the label already (with the idea that eventually we will also need to work on other product categories, ideas here can also be captured for these: Biologicals, Adding drones to a label that doesn't have aerial, etc.). Can be on different days and co-led by experts in this space.
    - Ag uses **Lead by:**
    - Non-Ag uses **Lead by:**
    - Mosquitocide **Lead by:**
    - Aquatics **Lead by:**
- For guidance:
  - From EPA (current situation):
    - The product must be either labeled for aerial application or
    - It must not prohibit aerial application or
    - It must not limit the application to only a specific type of application or
    - It must not limit the use to only ground applications
    - The UAS (drone) application must be in compliance with the label required application rate and concentration.
    - The UAS (drone) application must comply with all other label directions and safety and precautionary requirements such as PPE etc.

Pre-work: Bring actual labels with key sections highlighted, What is already available drone label language-wise, participants to bring examples from the US (and elsewhere as relevant) based on product type, Be prepared to bring must-haves/perspectives to share in break-out sessions

Thank you!

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