Final Report - 2020 CERSA Virtual Workshop

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Advances in Regulatory Risk Assessment of Pesticide Drift from Unmanned Application Systems (UAS) and Manned Aerial Application. December 1-3, 2020

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Presentations and Attendee List on Workshop Website: https://cersauas.wordpress.ncsu.edu/

Executive Summary

Spray drift is a major exposure pathway considered in pesticide regulatory risk assessment for human and environmental safety. Emergence of Unmanned Application System (UAS)-based pesticide application technology for crop production, mosquito control, and industrial vegetative management brings regulatory challenges and potential benefits for human safety and precision control of invasive weeds. Regulatory models like AgDRIFT® and AGDISP™ have been used by regulators for decades to estimate spray drift from manned aerial applications (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment). However, these models have not been updated to reflect many best management practices and newer technologies utilized today. This workshop focused on advancing the science around regulation of pesticide drift from both UAS and manned aerial applications. At the end of the workshop, attendees agreed upon a set of consensus statements:

"Under the auspices of the 2020 CERSA Virtual Workshop Advances in Regulatory Risk Assessment of Pesticide Drift from Unmanned Application Systems (UAS) and Manned Aerial Application, multiple stakeholders across public and private sectors agree that:

We ***promote the implementation of UAS platforms in a complementary manner*** *to conventional aerial and ground application equipment rather than a replacement for traditional application methods. UAS may have the potential to expand application capacity in specific use conditions.*

We recognize the need for the development of public-domain regulatory models, supported by high quality data, for the predictions of performance, drift and exposure from the use of UAS.

We commit to continuing the conversation on how to keep drift modeling for manned aircraft up to date, whether by revising default inputs or expanding assessments to consider higher tier simulations.

We further support continued research into the effect of pesticide droplet size on efficacy for all application platforms.

Therefore, we support a concerted, collaborative effort involving diverse stakeholders in academia, government research organizations, industry sectors, and other key groups to develop research protocols, empirical data & regulatory models in order to drive this effort forward."

Progress towards a harmonized regulatory framework for the use of UAS will involve different teams conducting work in a variety of areas. Communication and collaboration between groups such as the OECD Working Party on Pesticides Drone / UAV Subgroup will be required to avoid duplication of efforts.
It is likely that formation of a formal Industry Taskforce will be required to pool resources needed to fund the detailed studies required for regulatory assessments and to support development of publicly available spray drift and exposure models needed by regulators.

CERSA can continue to provide a forum for multi-stakeholder engagement on the topic of UAS regulation in the following ways.

1. In the short term, establish a multi-stakeholder working group for improving and modernizing drift modeling for manned aircraft to keep modeling up to date.
2. Facilitate discussions on potential modeling approaches for UAS.
3. Provide a forum for dissemination and feedback on the work of the Industry Task Group and OECD Working Party on Pesticides Drone / UAV Subgroup.

Overview of Workshop Discussions

1. What are the Potential Benefits for Broad Acre, Minor Use, and Industrial Applications?

Areas of Consensus where UAS brings potential benefits:

- Current UAS spray platforms have limited utility for broad acre use apart from spot and small acreage applications within broad acre situations. Future UAS with larger payloads and endurance have potential in this area, though these are likely to be fixed-wing platforms.
- UAS platforms have key advantages over conventional application techniques in inaccessible areas. As ground vehicles and operators on foot would not have to travel along the ground to reach these locations, there is the potential for lower environmental impact as well as benefits for operator safety. Specific applications where handheld applications and/or hard to access areas mentioned were:
    - Industrial vegetation management (e.g., herbicide treatments along oil and gas pipelines)
    - Vector control operations
    - Applications currently using abseiling or helicopter-mounted knapsack operators (e.g., invasive plant management)
- The potential for increased application precision via UAS was raised, mitigating drift and potentially reducing environmental loading when compared to conventional application equipment. Part of this discussion acknowledged the need for improved sensing, detection, and control technologies to realize this increased precision.
- UAS may have advantages in comparison to Multi-Purpose Vehicles currently used for railway weed control.

Topics where more discussion, information, or research is required:

- Use of UAS for herbicide resistance management was discussed and a better understanding of the benefit of UAS application on resistance management is needed.
- Potential of using UAS to increase application precision is acknowledged. However, not many data exist in this area.
- More information is needed on the economic benefits of UAS application, i.e., reduced labor and time requirements, for Vegetative Management applications.
- Potential benefits of downwash from UAS in terms of in-canopy deposition for dense crops.
- Potential biosecurity applications in urban environments, e.g., disinfection of sports arenas. Further work is needed to look at the efficacy of these applications as, like other applications, there remain many unknowns.

2. What Types of Uses May be of Most Interest to Growers and Where Can Conventional and UAS Technologies be Used Together?

Areas of discussion on areas where UAS may be of interest to growers:

- UAS may bring benefit for applications in areas difficult to access with conventional equipment. For example, in areas around power lines or muddy fields, UAS may be a companion technology to conventional application systems.
- If UAS platforms demonstrate lower drift exposure than conventional application systems potentially smaller in-field buffer zones could be required for UAS platforms.
- Applications at boundaries, fence lines, railways and easements were also discussed as potentially interesting areas for UAS application.
- Airblast orchard treatments were raised as a potential for combination treatment. It was envisaged that this would involve turning off the top nozzles of airblast sprayers (mitigating drift risk) and using the UAS, with its downwash, to treat the tops of canopies. However, more studies are needed to examine the feasibility of this approach from an economic and drift mitigation perspective.

- The potential of UAS as a route to professionalization of spray application in countries with small holder farmers was also discussed. Development of contractor-based spraying services could deliver both conventional and UAS applications allowing for application by trained operators, potentially decreasing operator exposure, environmental contamination and reducing the risk of misapplication of products. However, more studies are needed to understand UAS operator exposure.
- Pollinator protection via night-time UAS applications were discussed. It was pointed out that this application method is not unique to UAS.
- There was also some discussion surrounding the possibility of reduced labor costs with UAS. This was highlighted as a key benefit in rural China, where a rapidly aging agricultural workforce has led to the promotion of UAS, attracting younger workers to agriculture. Economic analysis needs to be performed.
- Public health/ vector control treatments were pointed out as another area where UAS have potential as a companion technology, with the ability to treat smaller areas economically.

3. What is the Path Forward for a Publicly Available Mechanistic Regulatory Model for Spray Drift from UAS? Are There Existing Models That Can be Used in the Short Term?

Proposed Path Forward

1. Create a working group of stakeholders. This group will initially identify and undertake information collection/ systematic review of existing data and identify knowledge gaps. (It is noted that the OECD Working Party on Pesticides Drone / UAV Subgroup has already conducted a review of existing data).
2. A conceptual model should be developed based on regulatory needs. This will need to involve good communication with regulatory agencies to both evaluate the conceptual model and to assess any data generation needs.
3. Generation of high-quality field data. Possibility of some wind tunnel work to support data collection- though needs discussion.
4. Validation of empirical/ regulatory model, scientific reviews, and public comments.
5. Model implementation in regulatory processes.

Available Supports and Tools

- Existing drift measurement protocols and guidelines (from ISO, SETAC Draw, EPA) can be used or adapted for use in data generation. It is vital to have an agreed protocol in place for any data generation, to allow comparison of data from a variety of trials.
- Open communication and collaboration amongst stakeholders is an integral part of any efforts going forward. This is through workshops as well as more formal groups such as the OECD Working Party on Pesticides Drone / UAV Subgroup.

Potential Hurdles/ Challenges

- AGDISP Pro is now available (from Mount Rose Scientific, developed by Continuum Dynamics). It incorporates the CHARM model for multi-rotor aircraft, but it is a commercial product and as such its source code is not available. This makes it non-desirable for regulatory use as transparent and publicly available models are a necessity.
- Any model requires validation and continued improvements. From prior knowledge of similar efforts undertaken by the Spray Drift Task Force, this task is very resource intensive.
- Harmonizing any new regulatory models among regulatory authorities would be desirable but may be difficult due to the different routes taken by different regulatory bodies.
- Many questions remain on the characteristics of UAS, with many of these not having simple answers, e.g., the interaction of vortices from multi-rotor UAVs with their wakes under a variety of configurations and different operational conditions still requires study.
- Although existing models like AGDISP™ are a good foundation, there is a need to review basic assumptions underlying them as some of these are seen to be possibly overly simplistic. Parts of the AGDISP™ model still reflect computer hardware limitations at the time of its initial development.
- There was also discussion that the existing model platform and approaches for ground and aerial applications should be the basis of the UAS model.
- Garnering agreement on standard protocols and UAS platforms will present difficulties, as there will certainly be different viewpoints on the best route to take for any data collection. The need for a ‘benchmark’ UAS platform for comparisons between different systems was raised but further discussions are needed to determine the configuration of a benchmark system for regulatory acceptance.
- The lack of operator exposure data to date surrounding UAS is a concern as trials and generation of this data is resource intensive. However, this may be covered (at least in part) by existing exposure assessment methodologies.
- While there are existing data on UAS application, it is unclear how useful it would be for any model development. Concerns exist over the quality of data collected to date. Many of the experiments were not designed for drift assessments and may have limited utility. The lack of standard testing protocols for UAS makes comparing different existing data sets difficult.

4. What is the Path Forward for an Improved/ Modernized Approach to Model Spray Drift from Manned Aerial Applications? How can AgDrift® and AGDISP™ be Updated to Incorporate Advancements in Manned Aerial Application Technologies?

Proposed Path Forward

1. Establish an expert working group under auspices of CERSA including representatives from US EPA, PMRA, NAAA, CAAA and modeling experts to improve/modernize approach to model spray drift from manned aerial applications.
2. In the short term, expert working group to evaluate AgDrift and AGDISP default input parameters (e.g. aircraft type, surface roughness and atmospheric stability) and recommend changes to reflect advancements in manned aerial application technologies.
3. Expert working group to develop a longer-term approach (e.g. probabilistic exposure consideration of wind speed and direction, Multiple Application Assessment Method in the models, impact of adjuvant and tank mix on droplet sizes) to modernize spray drift modeling of manned aerial applications.
4. Results to be presented during follow-up UAS workshop in 2022.

Available Supports/ Tools

- Open dialogue already exists between NAAA, registrants and regulators.
- FAA aircraft registration website exists which includes types of aircraft available, which could inform any updates required to aerial platform databases used in models.
- Further model development should be built on the existing model(s), although it was recognized that certain assumptions may be over-simplifications and may need to be modified.

Potential Hurdles/ Challenges

- Different requirements for different regulatory agencies were discussed. For example, Canada requires efficacy data but does not dictate droplet size.
- Lack of supporting data for improving modelling approaches from manned aerial applications. Any field trials are resource intensive and so further discussion is required on exactly what additional data are required, and how to collect this.
- Any improved models would require flexibility for tank mixes and incorporate effects of adjuvants on droplet size.
- The database used in the current regulatory models is out of date and needs to be maintained.
- Moving to a probabilistic modeling approach to consider wind speed and direction would be resource intensive.

5. What are the Highest Priority Regulatory Data Gaps with Respect to Off-Target Drift, Efficacy, Crop Residue and Occupational Exposure?

Data on off-target drift, crop residue, occupational exposure, and efficacy are required by regulators for an overall better understanding of UAS technologies and for policy development as a further step. The order of priority discussed in the workshop was off-target drift > crop residue > operational exposure > efficacy for collaborative efforts. It should be noticed that the priority ranking was based on current understanding of the technology, and it is subject to change as more data and research findings become available.

Areas of Consensus on Data Gaps

Drift

- Off-target drift was one of the highest priority data gaps. Reliable data on drift profiles of UAS are not currently available.
- Standard protocols for data collection are required. Protocols in development in ISO, SETAC DRAW, and EPA drift study guidelines may be useful.
- Generation of drift data for development of a model will require selection of a limited number of UAS platforms/ designs.
- There may also be the need for specifying a defined benchmark UAS system for comparison purposes.
- Comparison of UAS drift profiles with other application methods is needed.
- Questions exist regarding the effects of rotor wash, ground bounce and canopy mixing of sprays.
- The effect of adjuvants/ tank mixes for claims on labels (e.g., drift reduction) is a complex issue and is lower priority than other regulatory data gaps.

Efficacy

- The generation of efficacy data will likely be in the hands of the registrant community, whether this data is required to add UAS application language to product labels (e.g., submission for review to regulatory authorities as required by PMRA or for public health pest claims by EPA) or to assure that recommendations and label directions are valid (e.g., avoid litigation or user lack of efficacy claims).

- As with other application methods, registrants will need to develop efficacy data to assure that carrier / water volume, droplet size, UAS speed and height over the crop canopy, etc. that are recommended provide the expected efficacy and crop safety.

Crop Residue

- There is a need to compare crop residue data from UAS with other application methods. Some basic research on deposition would be helpful.
- It is anticipated that field-loading may be similar to conventional methods but uniformity of application (CV) from UAS could impact on more granular scale with the potential for hot and cold spots in treated areas depending on the pattern. This would have implications for residues and efficacy.

Occupational Exposure

- From an operator exposure perspective, UAS may be able to supplant some hand-held applications thereby reducing operator exposure during application. However, more studies on UAS operator exposure are needed.
- Existing metrics which consider operator exposure may be used for data generation if the relevant information on usage is gathered for UAS applications.

6. Recommended Path Forward

Progress towards a harmonized regulatory framework for the use of UAS will involve different teams conducting work in a variety of areas. Communication and collaboration between groups will be required to avoid duplication of efforts. Some existing groups identified during the workshop were:

- OECD Working Group on Pesticides Drone Sub-Group –charged with prioritizing regulatory data generation
- North American Remotely Piloted Aerial Application Systems (RPAAS) Working Group - established 50 members. 300 registrants from 23 Countries. This group will be valuable to disseminate the latest information on technical developments and regulation of UAS.
- ISO Standards (specifically ISO TC 23/SC6/ WG25 Unmanned Aerial Spraying Systems (UASS) 23117 series)
- SETAC DRAW (Spray drift mitigation in Europe) (https://www.spraydriftmitigation.info/)
- National Pesticide Safety Education Center (NPSEC) – Could be an important tool in the US for applicator training or webinars.

It is likely that formation of a formal Industry Taskforce will be required to pool resources needed to fund the detailed studies required for regulatory assessments and to support development of publicly available spray drift and exposure models needed by regulators. Discussions are on-going among industry representatives.
CERSA can continue to provide a forum for multi-stakeholder engagement on the topic of UAS regulation in the following ways.

1. In the short term establish a multi-stakeholder working group for improving and modernizing drift modeling for manned aircraft.
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