Emerging Agricultural Technologies Workgroup

Pesticide Program Dialogue Committee Meeting

October 27-28, 2021

PPDC Emerging Agricultural Technologies Workgroup: Roster, May 2021

- **Manojit “Mano” Basu**, CropLife America (Co-chair)
- **Ed Messina**, EPA/OPP (Co-chair)
- **Ruben Arroyo**, Riverside County Department of Agriculture and Measurements Standards
- **Dan Cederberg,** Teejet
- **Gilbert Del Rosario**, Corteva Agriscience
- **Adam Finch**, BASF
- **Josh Friell**, The Toro Company
- **Brad Fritz,** USDA, ARS
- **Rebecca “Becca” Haynie**, Syngenta
- **Ramon Leon**, North Carolina State University
- **Lauren Lurkins**, Illinois Farm Bureau
- **Daniel Markowski**, Vector Disease Control International
- **Dan Martin,** USDA, ARS
- **Jacob Moore**, ADAMA
- **Robby Personette**, Wisconsin Department of Agriculture
- **Damon Reabe**, National Agricultural Aviation Association
- **Karen Reardon**, RISE (Responsible Industry for a Sound Environment)
- **Margaret Reeves**, Pesticide Action Network
- **Scott Shearer**, Ohio State University
- **Bryan Sanders**, HSE-UAV
- **Christina Stucker-Gassi**, Northwest Center for Alternatives to Pesticides
- **Nick Tindall**, Association of Equipment Manufacturers
- **Anne Turnbough**, AMVAC Chemical
- **Greg Watson**, Bayer

CHARGE QUESTIONS

- How should EPA obtain a greater understanding of how the use of emerging agricultural technologies leads to reduced or increased risks that differ from those resulting from current methods?

- What changes to EPA's approach to pesticide labels, if any, are needed to accommodate emerging technologies?

Emerging Technology Workgroup Meeting Cadence

- January 14, 2021
- February 11, 2021
- March 11, 2021
- April 8, 2021
- May 6, 2021
- June 3, 2021
- July 1, 2021
- July 29, 2021
- August 26, 2021
- September 23, 2021
- October 21, 2021

Presentations:

- **February 11th:** Presentation on Emerging Agricultural Technologies by American Equipment Manufacturers
- **April 8th:** Presentation on the December 2020 CERSA Workshop by Jane Tang of Bayer
- **June 3rd:** Presentation on Subsurface Pest, Soil and Microbiome Detection by Peter Porpiglia of AMVAC
- **July 29th:** Presentation on AMVAC SIMPAS Cartridge and Refillable Container System by AMVAC
- **July 29th:** Presentation from Greeneye Technology on their selective spraying system, and use of artificial intelligence

Deliverables Discussed at ET WG

- Deliverable 1 – List of Emerging Technologies
  - List of emerging technologies that can be used for or, in support of, or in place of pesticide application
  - Any regulatory oversight or risk assessment changes by EPA needed to facilitate their use
- Deliverable 2: Deep dive on Autonomous Application Platforms operated remotely and/or manually
  - How these technologies lead to reduced or increased risks that differ from those resulting from current methods
  - What changes to EPA's approach to pesticide labels, if any, are needed to accommodate these technologies

Deliverable 1: List of Technologies

Hardware

- UAVs/Drones
- Spray/Nozzles
- Ground Robots
- Equipment Improvements to Existing Application Equipment

Data and Analytics

- Maps
- Statistical Analysis
- Prescriptive Agriculture
- Artificial Intelligence

Deliverable 1: Technologies List

Equipment Improvements

- Autonomous Spray Systems Aboard Current Manned Aircraft and Ground Sprayers
- Spot Farming
- Boundary Mapping
- Smart Guidance
- Boom Height Control
- Rate Control
- Section Control
- Equipment Mounted Weather Stations

Ground Based Robots

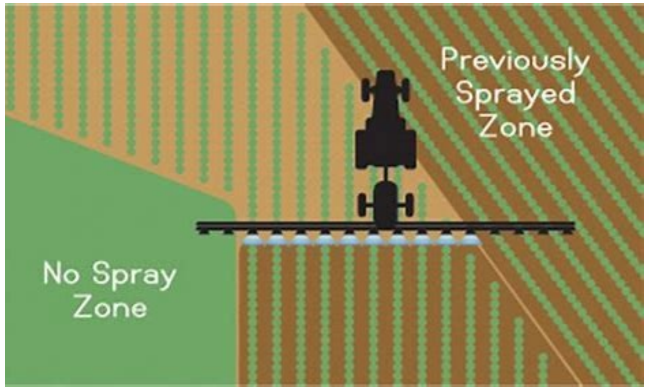
- Land Care Robot
- Robot for Mechanical Weed Control
- Tool-Carrying Robot
- Bug Vacuum
- Autonomous Tractor
- Autonomous Ground Sprayer

Spray/Nozzle

- Nozzles (dramatically reduce/ eliminate drift)
- Direct Injection
- Stacked (Tiered) Nozzles
- Targeted Spray Technology
- Spray Width Modulation

Technologies (agnostic of application method)

- GPS Guidance
  - Track machine’s position in the field
  - Enables other control technologies
- Boundary Mapping
  - Ensures application is taking place in the intended area
- Smart Guidance
  - Maintain consistent application speeds that help deliver consistent droplet size
- Targeted Spray Technology (Autonomous application)
  - Distinguish difference between weeds and crops
  - Potential to reduce application by up to 90%
  - Works with pre and post emergence applications
- Machine Mounted Weather Station
  - Mobile weather stations mounted directly on the sprayer
  - Allows for more accurate information to assist in mitigating spray drift



Autonomous Application Platforms – Drones (DM)

- Unpiloted aerial vehicles (UAVs), also known as drones or unmanned aircraft systems (UASs), allow for efficient data collection in the field on soil moisture, crop health, and other useful information
- Additionally, they can be used to apply pesticides and fertilizers precisely and only in areas where they are needed

Emerging Tech (Drones)

- Increased digital solutions such as satellite-driven technology, big data analytics, autonomous vehicles, and artificial intelligence are helping farmers to make better, more informed, and more efficient crop-growing decisions
- Drones are an important component of precision agriculture and have the potential to assist with achieving sustainable agricultural goals
- The precision agriculture sector has responded to increased demand and there is now a wide array of drones available
- The need to produce significantly more food and feed while using fewer pesticides coupled with harvest losses and shrinking agricultural land has accelerated innovation in the drone realm
- Drones are garnering worldwide interest as an application technique for pesticides

Data Collection (in report)

- Methodology:
  - High-resolution digital cameras with sensors designed to cover both the visible (red, green, blue – "RGB" – or VIS) and near-infrared (NIR) portions of the electromagnetic spectrum, at wavelengths of 400-700 nm and 750-1400 nm, respectively.
  - Multispectral and hyperspectral sensors may be used to detect light in multiple discrete ranges within the NIR-VIS spectrum for specific monitoring tasks.
  - Thermal sensors, which detect infrared radiation in the long-wavelength region (7.7-13 µm, or 7700-13,000 nm) may be used to measure the temperature of plant canopies and other objects
  - LIDAR (light-radar) sensors emit their own light in the form of a laser beam and measure the time for the light to be reflected at a surface and returned to the sensor; thus, they can generate accurate **topographical data** and can be used to estimate canopy volume by measuring the distance between canopy height and ground surface.

Use Cases (in report)

- Estimating Soil and Field Conditions
  - Detect soil erosion, drainage, salinity, acidity, nutrient deficiencies, and applied nutrient loss after flooding, and monitor drainage and fertility in general
- Seedling Emergence
  - High resolution mapping can be used to identify any areas of planting where crop emergence is delayed or not evident because of environmental conditions, thus allowing for possible replanting in the narrow time window available
- Crop Monitoring
  - Real time assessment of vegetative stage, overall biomass, and ultimate yield
  - Optimization of fertilization
  - Assessment of damage resulting from storms, farm equipment, or malicious intrusion
  - Evaluation of different hybrids and cultivars in experimental plantings

Use Cases – Continued (in report)

- Crop Health Assessment
  - Monitoring for insect infestation and bacterial, viral, or fungal diseases, and designing precise pesticide applications (in terms of application rate and area covered) to treat them, can help minimize the amount of pesticide used
- Water Management
  - Efficiently monitor water stress in crops on a timely basis and over large areas. The data generated can be used to fine-tune irrigation systems to optimize water delivery, increasing supply to areas under stress while avoiding unnecessary over-supply in other areas
- Weed Detection
  - Multispectral sensors are most utilized for generating images that distinguish between weeds and crops. The images are used to optimize herbicide treatment, thus limiting both herbicide quantity to be applied and areas to be treated
- Livestock Monitoring
  - Real-time surveillance of the location, number, and behavior of livestock, and for confirming the adequacy of pasture fencing and gates, water supply, feed troughs etc.

Pesticide Applications (in report)

- Access–Limiting crop production
  - Muddy fields and/or areas with physical impediments such as power lines, and uneven topography. Drones offer a complimentary approach to, rather than a replacement of, conventional methods of PPP application such as manned aerial and ground applications
    - UAVs have been widely employed in Asia for over 30 years and have been recently approved in Europe for specific applications on sloped vineyards and orchards (Germany and Switzerland)
- Data Gap between Drone Technology and Existing Application Technology
  - Although similar in many aspects to traditional aerial and precision PPP applications, there are variables that may need further understanding for drone-based pesticide applications
    - Many of the above technologies' utilization are not limited to unmanned systems
  - The increased interest in drone technology and the need to further explore potential differences in drone technology compared to existing application techniques has led to formation of several working groups
    - E.g., OECD WPP Drone Sub-group, RPAAS, UAV Task Force, CLA Drones Working Group plus continuing to work with CERSA

Unique Benefits and Challenges (in report)

- Benefits
  - Potentially less worker exposure to pesticides and time/labor savings particularly in areas where hand application is needed
  - An opportunity to use this technology in tough and difficult conditions (e.g., cliff sides) where traditional application methods may not be feasible or present additional hazards
  - Potential to reduce environmental loading of pesticide/fertilizer/water as spot or partial field applications may become more viable
  - Depending on equipment type, reduced fuel use / emissions and a lower cost to entry may be realized in many scenarios
- Challenges
  - Benefits may be over-stated early in development and roll-out and therefore quantifying benefits as technologies evolve is very important
  - Safety, implementation, and regulatory compliance (What additional information / data is required)
    - Offsite movement that may impact applicators, bystanders, and/or wildlife that may be different than conventional application methods?
    - Are there differences in the applications that may impact pesticide efficacy and/or tolerances or result in crop injury?
    - What applicator training will be required and who will certify?
    - What label language changes will be required?

Conclusion

- Emerging technologies will continue to arise during this dynamic and important time in agriculture
  - They are a central element to solving one of society's most pressing issues: feeding a growing population while minimizing farming's impact on the environment and human health
- Sustainable and climate-smart production will require this to be achieved by managing the economics as well as factors such as soil health, erosion, water use, and prudent use of agricultural inputs
- Emerging technologies will play an increasingly important role in the non-agriculture sector, namely vector control, and enabling access to dangerous terrain thereby increasing worker safety.
- As with the adoption of any new technology, it will only be successful if it brings benefits to farmers / other user groups, the environment, and society
- As these efforts progress, the ETWG is committed to working with all stakeholders within transparent, science-based, and flexible regulatory frameworks that can enable these technologies to continually evolve for the future of farming
- EPA needs to continually review and update the pesticide risk profile to account for any changes to risk due to the adoption of these technologies

Next Steps

- EPA Opportunity:
  - Adoption of Digital Mindset
  - Label
    - Standard language for current application methods, and an efficient update process
  - Risk Assessment approach
    - Consider operator and/or dietary exposure; environmental load, predictive exposure model development/adaptation for off-site movement
- Future Research Need
  - Information / Data potentially needed to inform risk assessment(s)
- Continue Engagement with External Stakeholders (CERSA, OECD, RPAAS, Countries, etc.)

Recommendations

- We recommend extending the term of the Emerging Technology Working Group
  - Extend additional more year to address revised charge questions
  - Maintain current membership – but expand if needed to address revised charge questions
- Potential Revised Charge Questions
  - Is there information on availability and affordability of emerging technologies for **all** communities?
  - To account for emerging technologies, how should EPA OPP establish a process for:
    - determining what additional information / data is needed
    - updating risk assessment practices / SOPs
    - updating label language
  - How should EPA OPP work toward establishing a 'digital mindset' for its program & staff?
    - use label process to start?