Spray Drones: Opportunities and Challenges

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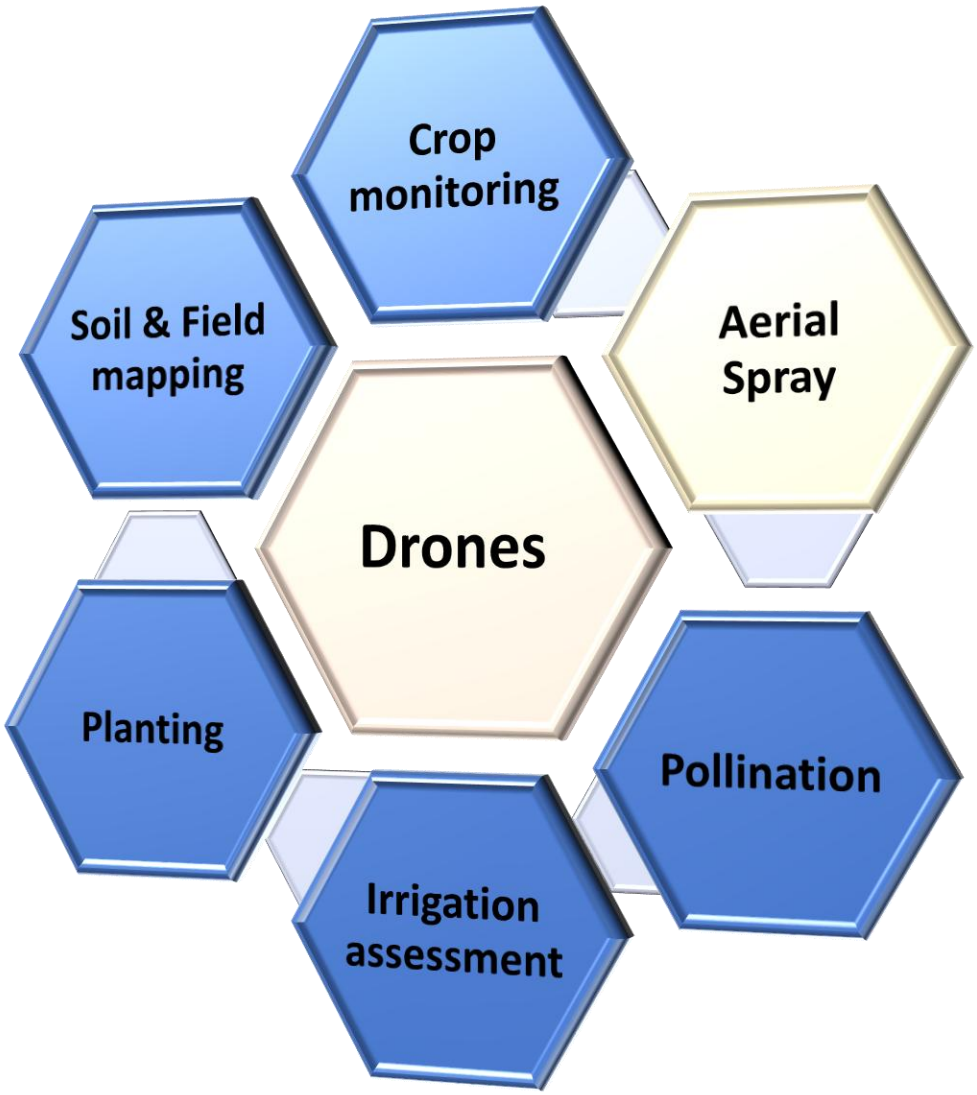
Outline of the Presentation

- Application and Benefits
- Different types of Spray Drones
- Components of Spray Drones
- Parameters Influencing Spray Quality
- Fungicide Application: Case Study
- Spray Drone Rules and Regulation

Spray Drones: Applications & Benefits



Spray Drones: Applications & Benefits

Drone Vs Ground Rig Vs Aerial Plane

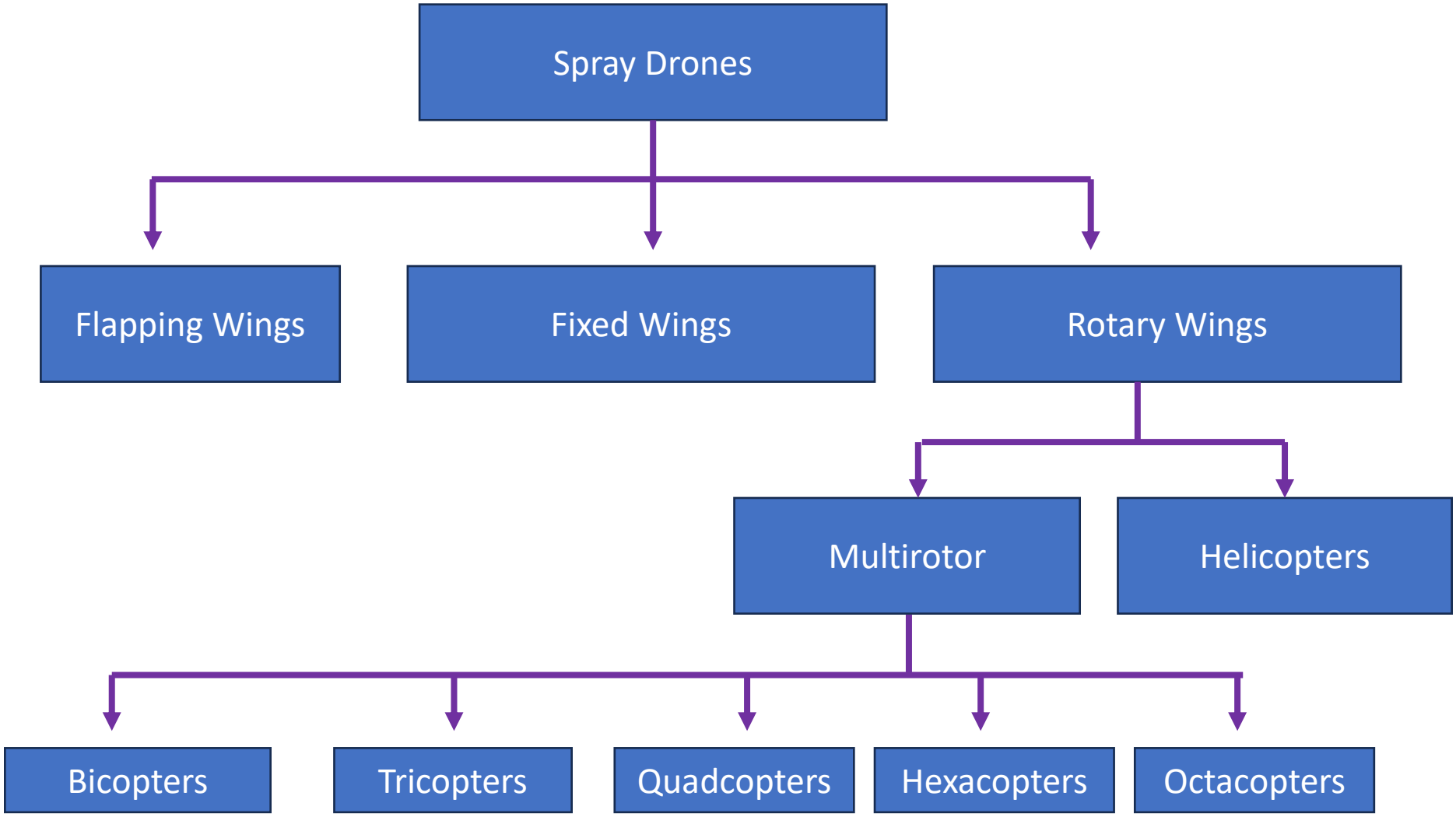
- Cost per acre
- Coverage quality
- Field accessibility

Drones can enter fields when:

- The soil is too wet for ground rigs
- Crops are too tall for high-clearance sprayers
- The field is irregular, terraced, or obstructed
- Timing is critical (disease onset, insect outbreaks)

Cost-effective
Time-effective
Labor saving
Difficult to reach areas & night application
Reduced Environmental Pollution
Improved Maneuverability
Decreased Chemical use
No exposure to chemical
Efficient coverage

Spray Drone Types



Fixed-wing Spraying Drones

Pyka received approval from the Federal Aviation Administration (FAA) to operate this drone commercially in the U.S., making it the largest UAS (unmanned aircraft system) ever cleared for agricultural spraying in the country.

Figure. Fixed wing Pyca drone

Multirotor Spraying Drones

Bicopter
XAG V40

Quadcopter
DJI T30

Coaxial Quadcopter
DJI T40

Hexacopter
DJI T16

Octocopter
DJI MG-1P

Helicopters Spraying Drones

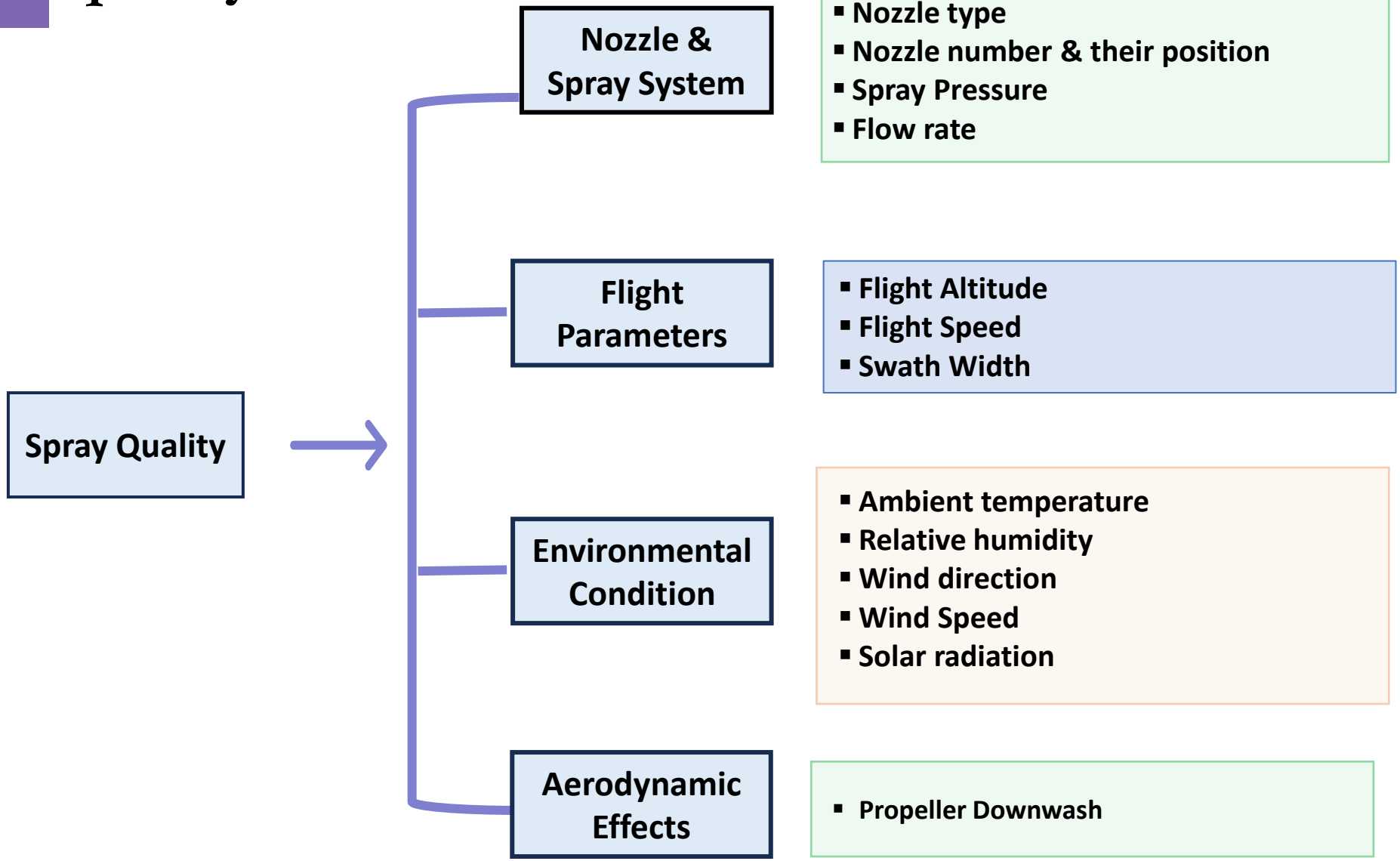
Sprayhawk Spray Helicopter

Yamaha Spray Helicopter

Drone Sprayer Components

- ❑Tank
- ❑Pump
- ❑Pressure gauge
- ❑Hoses
- ❑Filters
- ❑Nozzles
- ❑GNSS Receiver
- ❑Anti-collision sensor

Main Parameter influencing Drone Spraying quality



Main Parameter influencing Drone Spraying quality

Spray the drone with a boom

A spray drone with a long boom and far away from the rotor might not be ideal because it reduces deposition and coverage and greatly increases drift risk.

Spray Drone with nozzle instead of boom

A sprayer drone with multiple nozzles under each rotor

Drone for Fungicide Application

- Study Sites: Topeka and Roseville

Collaborator: Dr. Tina Sullivan

- **Treatments:**
  - **T1 – Control**
  - **T2 – Standard Application**

(12 ft height and 32.8 fps speed)

  - **T3 – High Altitude Application**

(18 ft height, 32.8 fps speed)

  - **T4 – Slower Speed Application**

(12 ft height, 23 fps speed)

Fungicide: Azoxy Prop SE @12.5 oz/ac

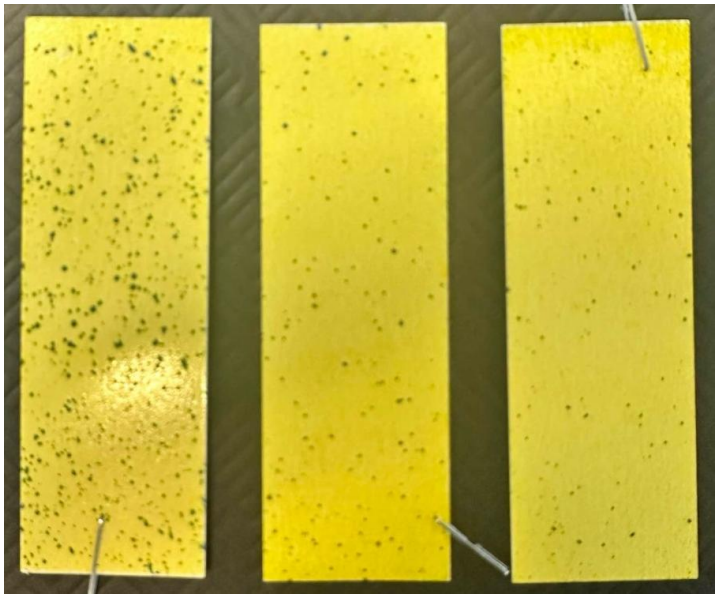
Drone for Fungicide Application

- Wet paper test

Top canopy
Mid canopy
Bottom canopy

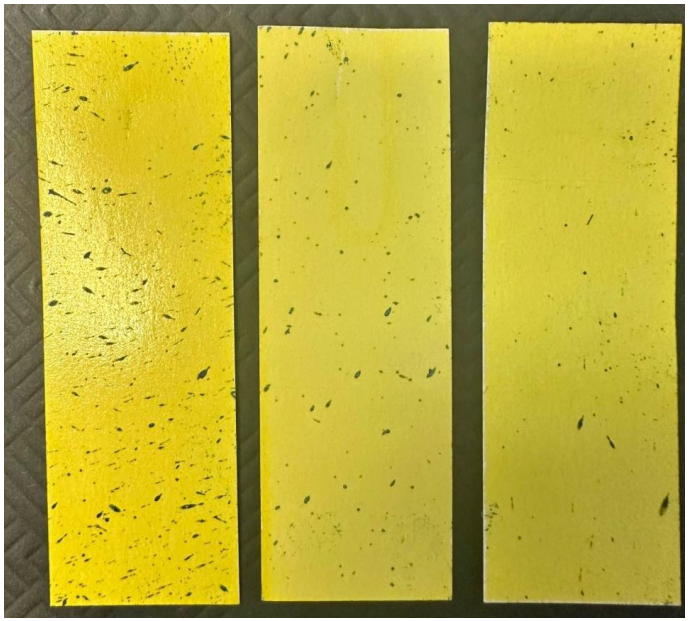
Drone for Fungicide Application

- Slow speed
(12 ft height, 23 fps speed)



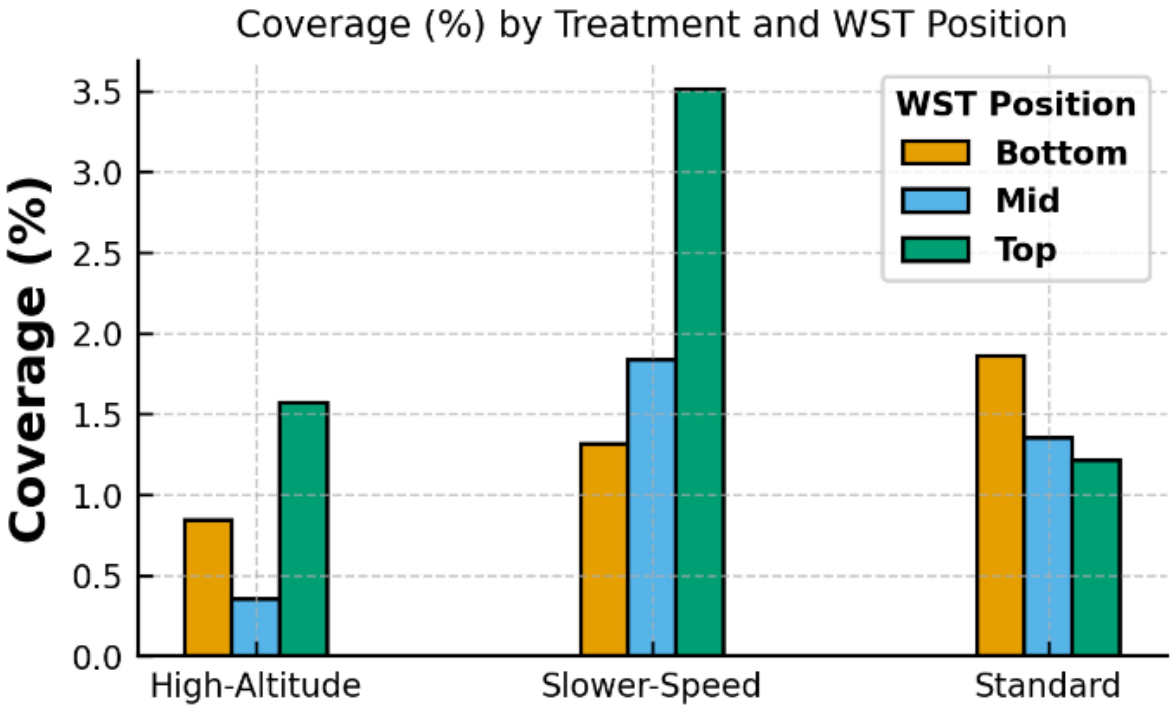
Top canopy, Mid canopy, Bottom canopy

- Standard speed
(12 ft height and 32.8 fps speed)



Top canopy, Mid canopy, Bottom canopy

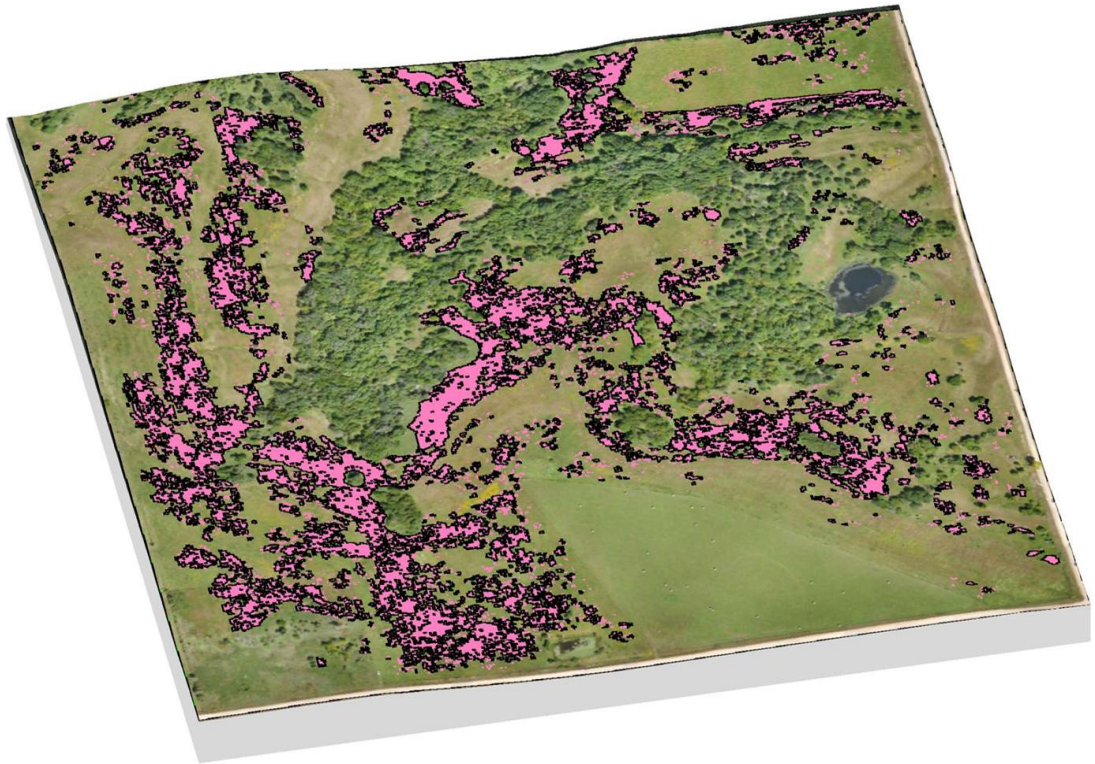
Drone for Fungicide Application



Mean spray coverage (%) on wet-tissue (WST) cards by treatment and canopy position (Bottom, Mid, Top). Treatments: High-Altitude (18 ft, 32.8 ft/s), Slower-Speed (12 ft, 23 ft/s), and Standard (12 ft, 32.8 ft/s).

Future Trend in Spray Drone

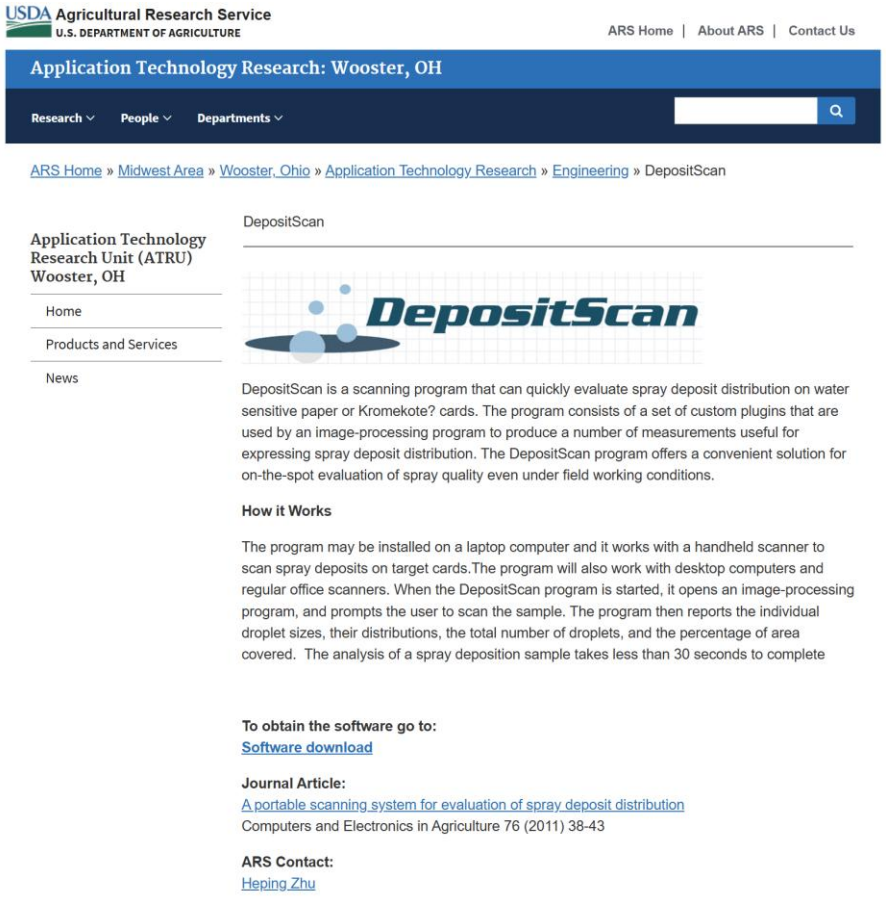
- **Spot application**
- **Swamp Drones**
- **Real-time application**



Software for WSP Analysis

DepositScan — the free USDA-ARS software for analyzing water-sensitive paper (WSP) spray deposits.

It processes scanned WSP images to report coverage (%), droplet count/density, size distribution, and VMD.



Spray Drones: Rules and Regulations

1. Federal Aviation Administration (FAA) Regulations:

Remote Pilot Certification: Operators must obtain a Remote Pilot Certificate under Title 14 of the Code of Federal Regulations (14 CFR) Part 107. This involves passing an aeronautical knowledge test at an approved testing center. The examination fee is approximately $175.

Part 137 Certification: For agricultural operations involving the dispensing of substances, such as pesticides, operators need an Agricultural Aircraft Operator Certificate under 14 CFR Part 137. This certification ensures that the operator meets specific requirements for agricultural aviation.

Exemptions for Drones Over 55 Pounds: If the drone weighs 55 pounds or more, including the payload, operators must obtain exemptions from certain FAA regulations. This process involves demonstrating that the drone can operate safely within the National Airspace System.

Spray Drones: Rules and Regulations

2. Kansas Department of Agriculture (KDA) Requirements:

Commercial Applicator Certification: Operators must be certified as commercial pesticide applicators in the appropriate category, such as Agricultural Pest Control. This certification ensures that the operator is knowledgeable about safe pesticide application practices.

Pesticide Business License: If operating as a business, a Pesticide Business License from the KDA is required. This license verifies that the business complies with state regulations regarding pesticide application.

Equipment Registration: Operators must provide the KDA with details about the drone, including make, model, and serial number, along with proof of FAA registration and pilot certification.

3. Pesticide Label Compliance:

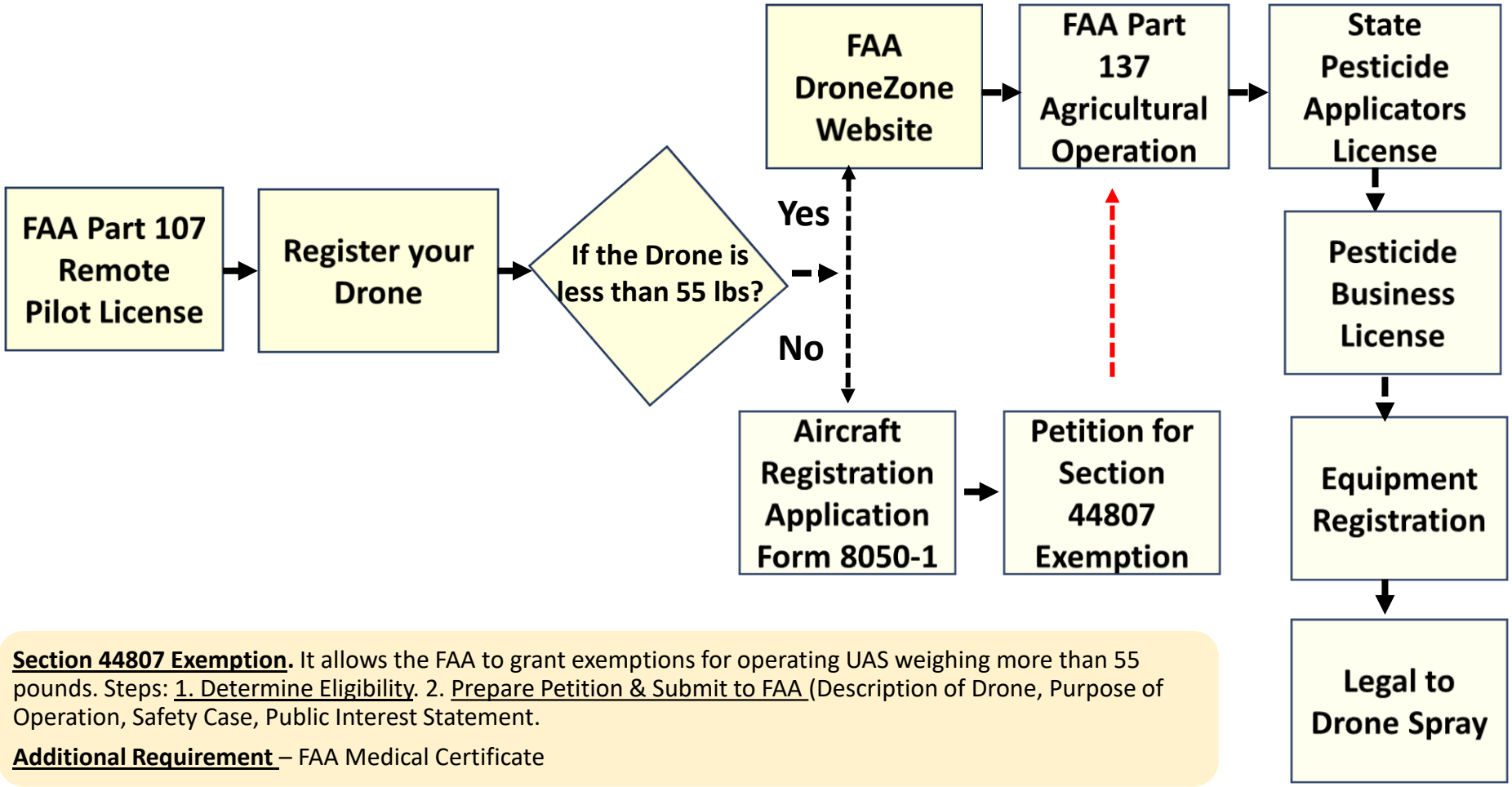
Adherence to Label Instructions: If a label prohibits aerial application, using a drone for that pesticide is not permitted. Ensure that application rates and methods align with label specifications.

4. Operational Considerations:

Flight Operations: Drones must be operated in accordance with FAA regulations, including maintaining visual line of sight and adhering to airspace restrictions.

Safety Measures: Operators should implement safety protocols to prevent off-target movement or volatilization of pesticides, considering factors like downdraft effects.

Steps to Obtain a License for Aerial Spraying with Drones



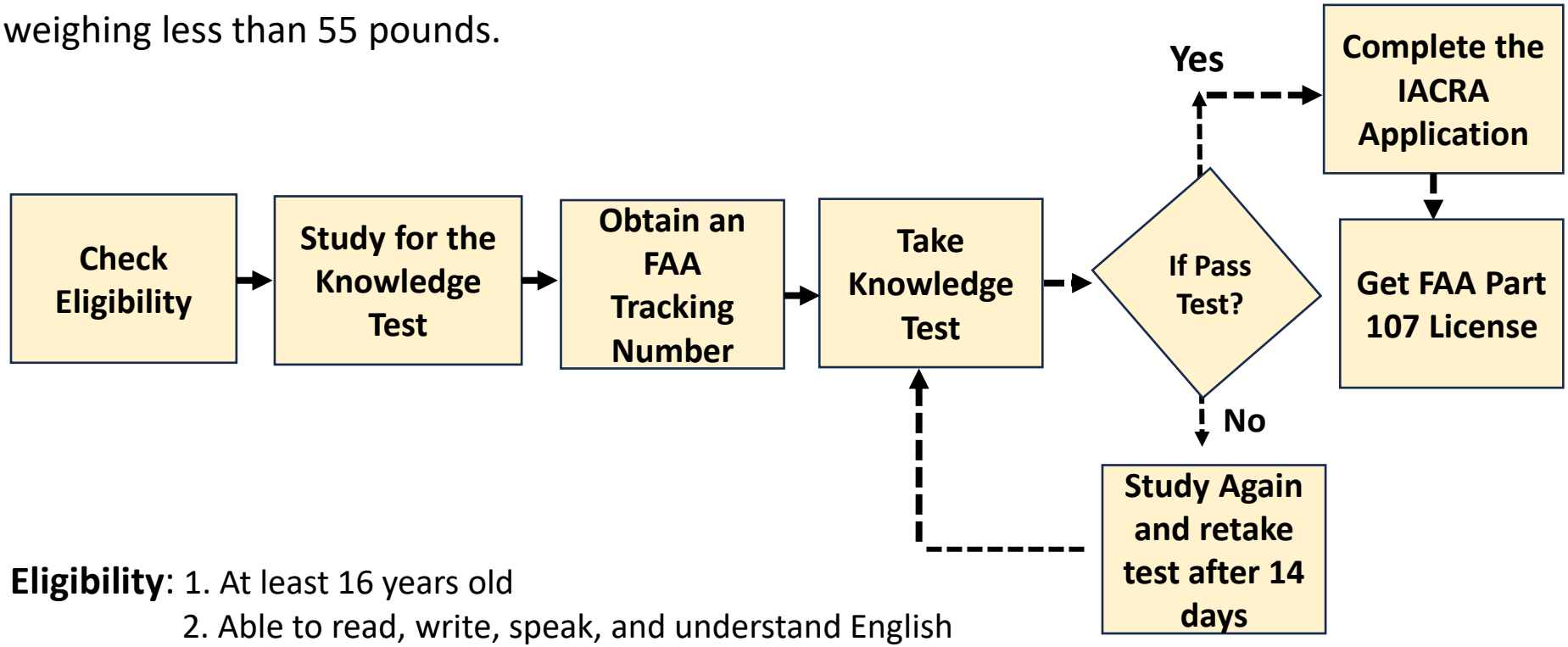
Section 44807 Exemption. It allows the FAA to grant exemptions for operating UAS weighing more than 55 pounds. Steps: 1. Determine Eligibility. 2. Prepare Petition & Submit to FAA (Description of Drone, Purpose of Operation, Safety Case, Public Interest Statement.

Additional Requirement – FAA Medical Certificate

Figure: Steps to Obtain a License for Aerial Spraying Drone Operations in Kansas.

FAA Part 107 Remote Pilot License

FAA Part 107: Governs the commercial use of small UAS weighing less than 55 pounds.



Eligibility: 1. At least 16 years old
2. Able to read, write, speak, and understand English
3. In physical and mental condition to safely fly a UAS
4. U.S citizenship is not required, but one must be able to legally operate a drone in the U.S.
5. Identification/Valid government-issued photo ID

Figure: Steps to Obtain a FAA Part 107 Remote Pilot License

Common Spray Drones in the Market

DJI Agras T40, T20, T30

XAG P100 Pro

Hylio

Guardian Ag

EA-J100

- Under the American Security Drone Act, federal agencies and government contractors are prohibited from purchasing or using Chinese-manufactured drones, which include models from DJI and XAG.
- Federal department, agency, or working under a federal contract, you cannot use new XAG drones.
  - Farmers, private businesses, and commercial operators (like crop sprayers) are not subject to that ban and continue using DJI and XAG drones freely.

Future Trends in Agricultural Drones

AI- Drones: Brains in the Sky

- Make data-driven decisions in real-time.
- Use computer vision to identify crop stress, disease, and weeds.
- Enables real-time scouting with onboard analysis.
- AI-based path and Obstacle avoidance
- Integrate with farm management platforms.

Digital Ag and AI survey

Thank you for your Attention !




Any Questions?

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