

Spray Drones: Opportunities and Challenges

Deepak Joshi, Ph.D

Assistant Professor & Precision Ag
Extension Specialist

Kansas State University

Southeast Ag Applicator Day

Parson, KS

Date: 12/01/2025

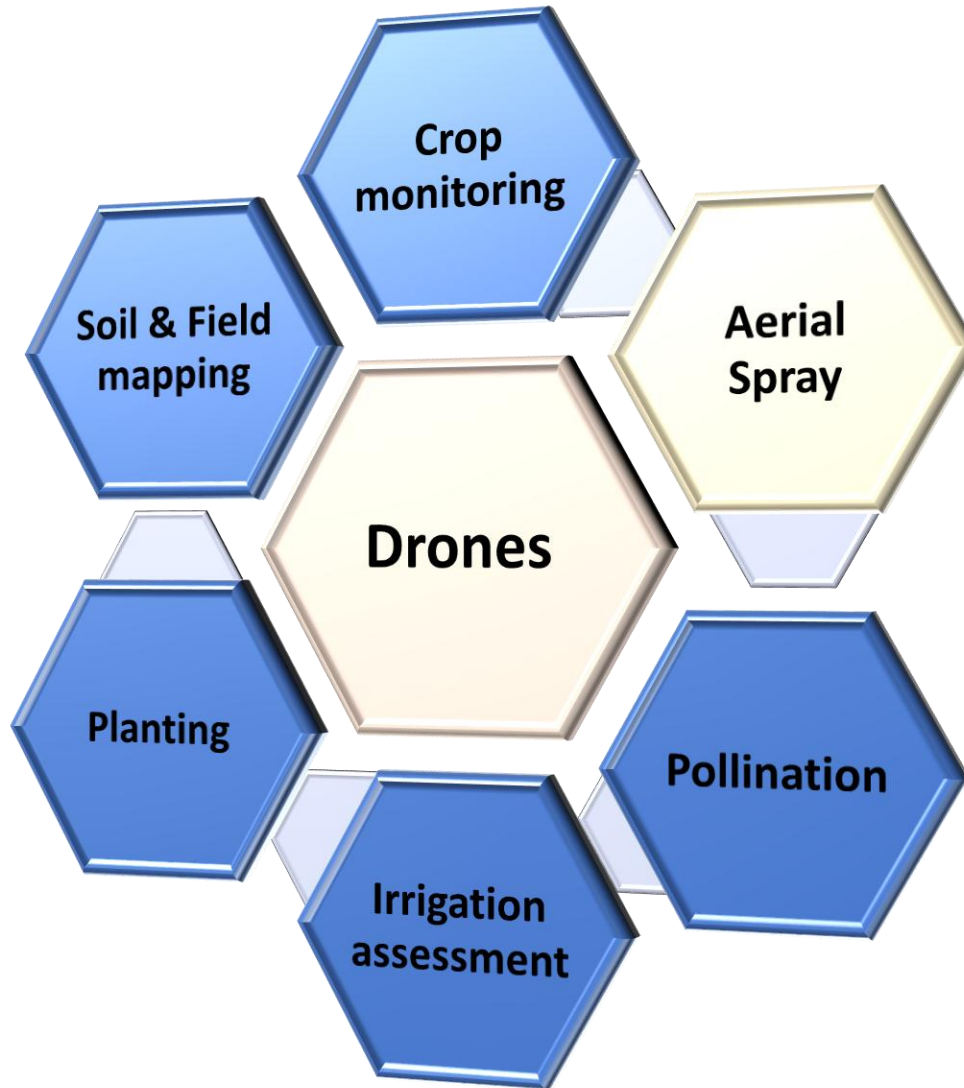
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Outline of the Presentation

- ❑ 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



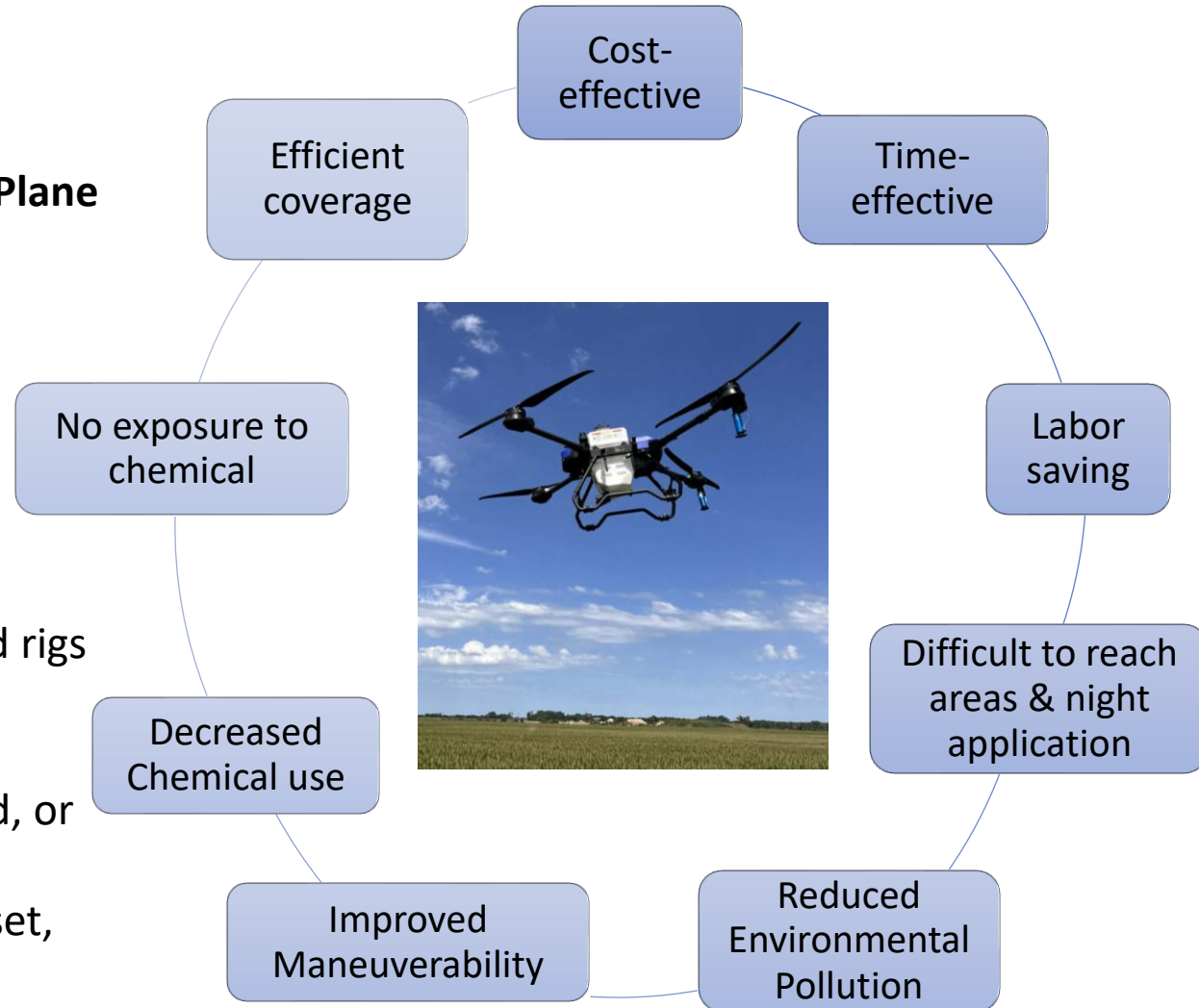
Spray Drones: Applications & Benefits

Drone Vs Ground Rig Vs Aerial Plane

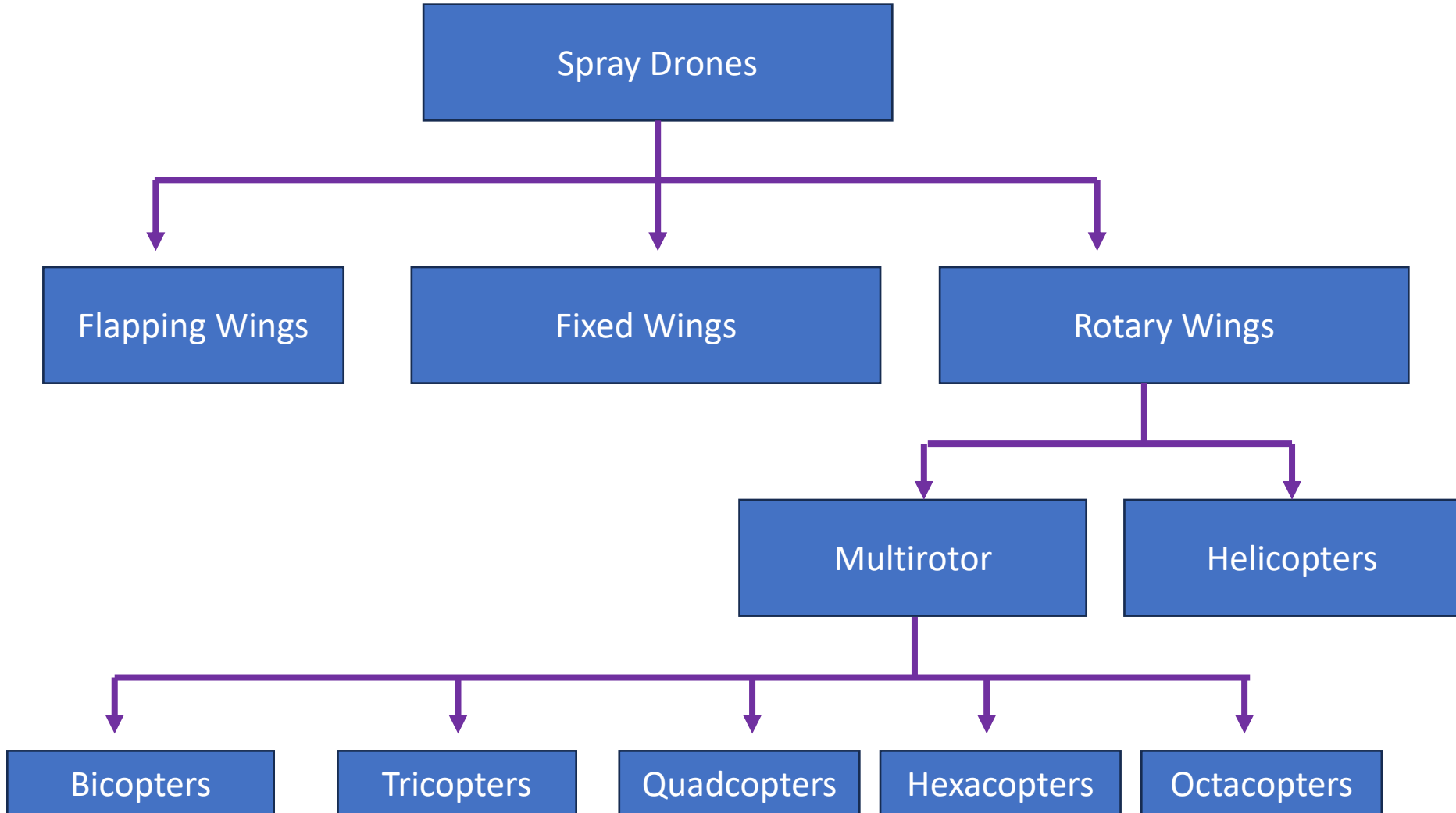
- Cost per acre
- Coverage quality
- Field accessibility

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)



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 Pyka drone

Multicopter 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



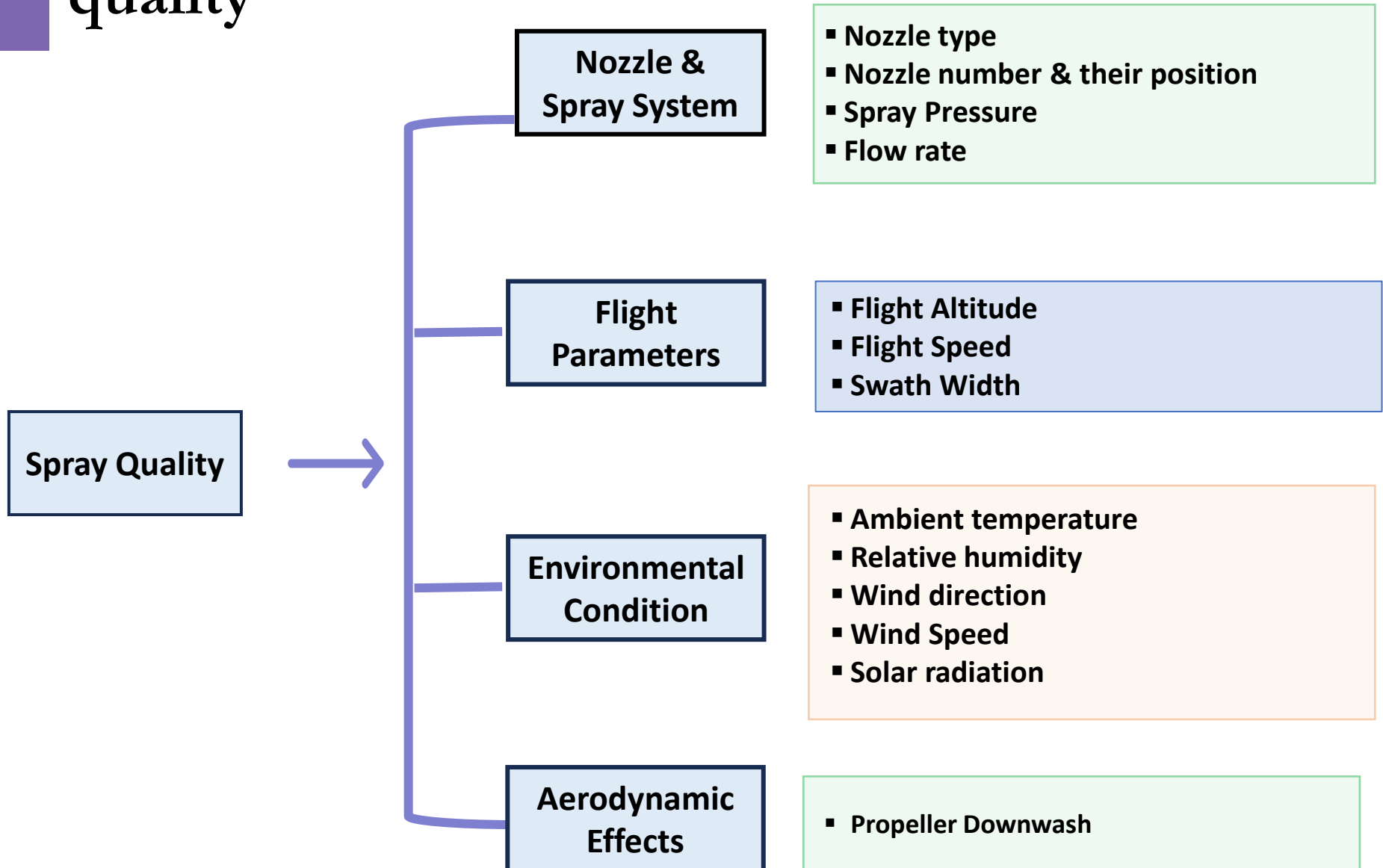
Yamaha Spray Helicopter

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

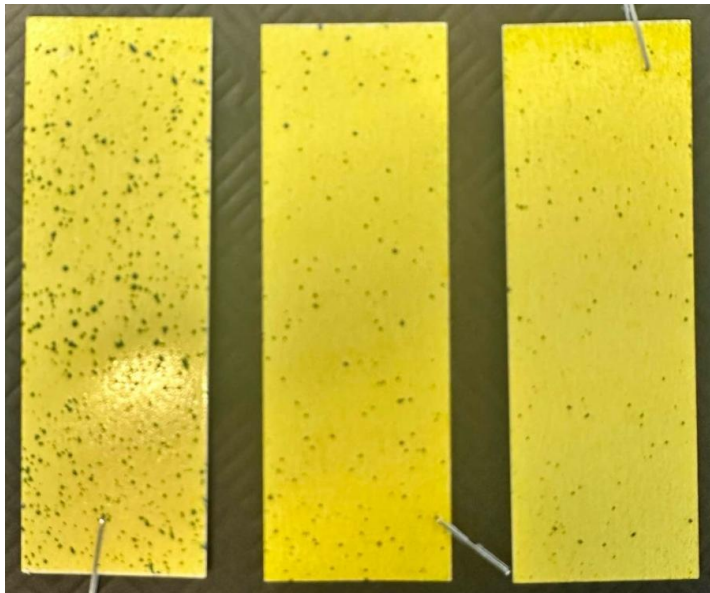
- ❑ Wet paper test



Top canopy
Mid canopy
Bottom canopy

Drone for Fungicide Application

Slow speed
(12 ft height, 23 fps speed)



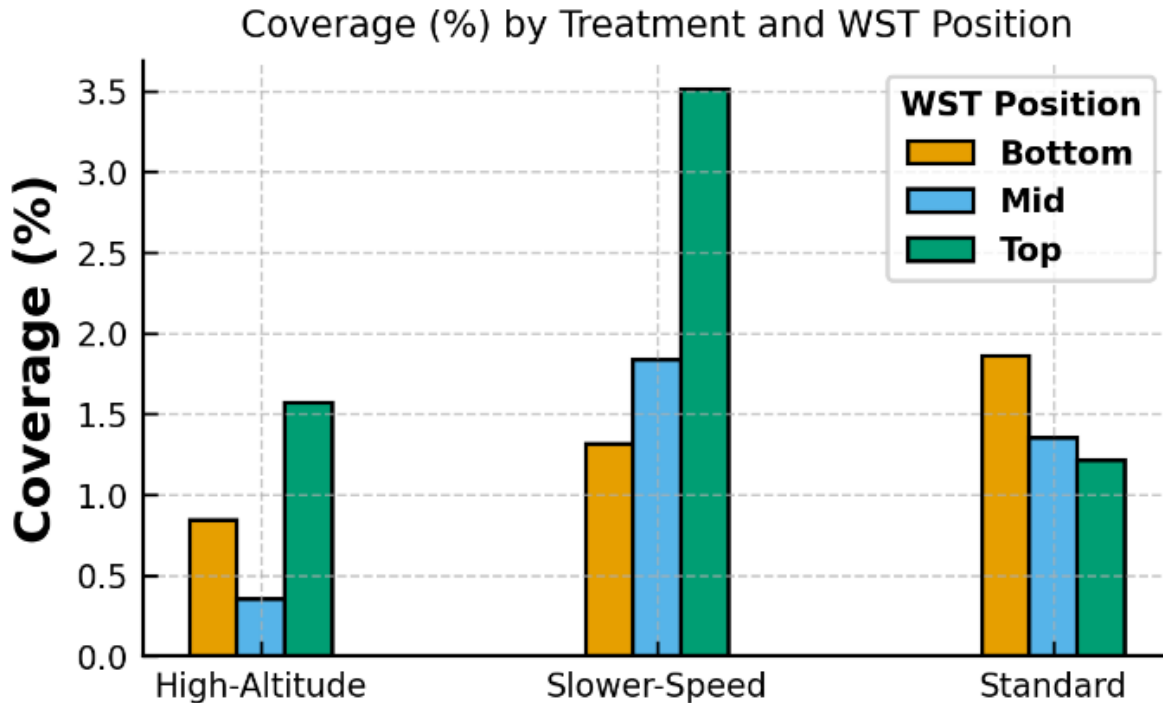
Top canopy, Mid canopy, Bottom canopy

Standard speed
(12 ft height and 32.8 fps speed)



Top canopy, Mid canopy, Bottom canopy

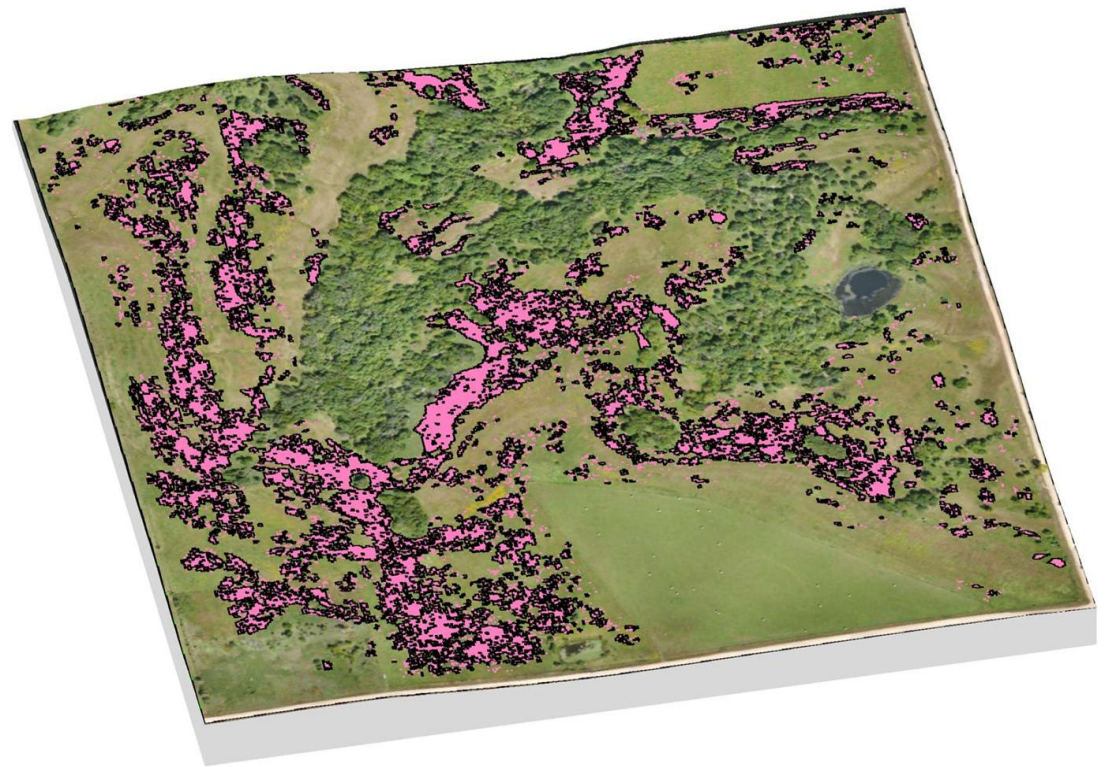
Drone for Fungicide Application



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

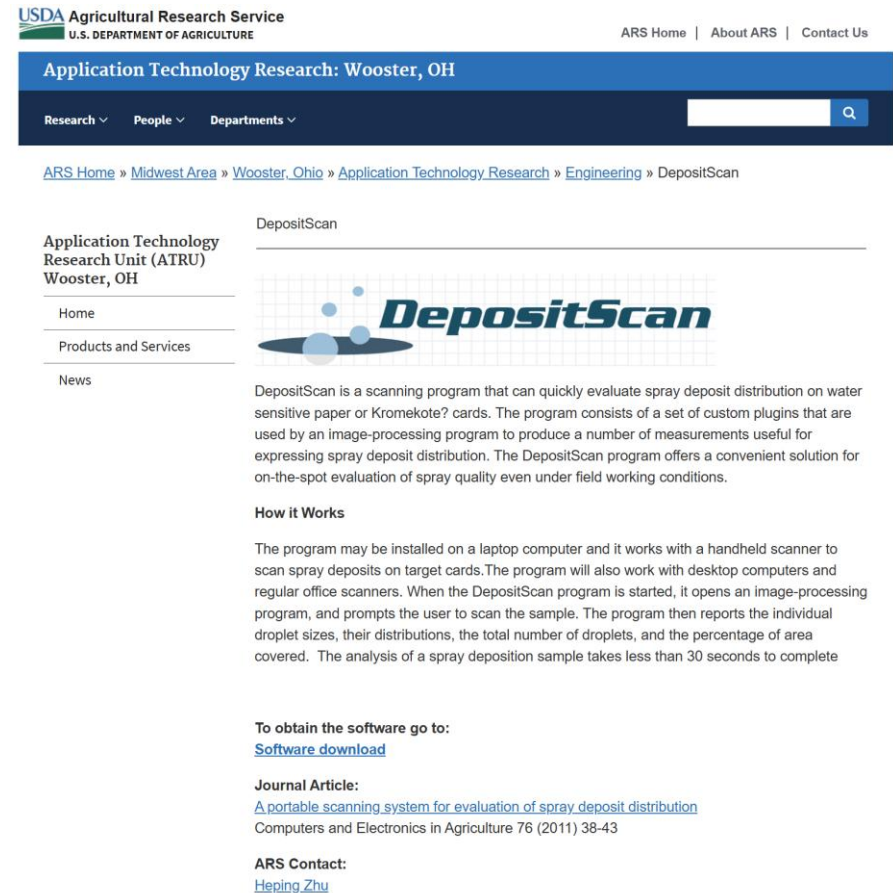
- Spot application
- Swamp Drones
- Real-time application



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.



The screenshot shows the USDA Agricultural Research Service website. The header includes the USDA logo and navigation links for ARS Home, About ARS, and Contact Us. The main navigation bar is blue with the text "Application Technology Research: Wooster, OH" and a search box. Below the navigation bar, there are dropdown menus for Research, People, and Departments. The breadcrumb trail reads: ARS Home » Midwest Area » Wooster, Ohio » Application Technology Research » Engineering » DepositScan. The page title is "DepositScan". The left sidebar contains the text "Application Technology Research Unit (ATRU) Wooster, OH" and links for Home, Products and Services, and News. The main content area features the DepositScan logo, which consists of a grid of dots with three blue circles of varying sizes and the text "DepositScan" in a bold, blue font. Below the logo, the text describes the software: "DepositScan is a scanning program that can quickly evaluate spray deposit distribution on water sensitive paper or Kromekote? cards. The program consists of a set of custom plugins that are used by an image-processing program to produce a number of measurements useful for expressing spray deposit distribution. The DepositScan program offers a convenient solution for on-the-spot evaluation of spray quality even under field working conditions." The section "How it Works" explains that the program can be installed on a laptop and works with handheld, desktop, and regular office scanners. It prompts the user to scan a sample and reports individual droplet sizes, distributions, total number of droplets, and the percentage of area covered. The analysis takes less than 30 seconds. The "To obtain the software go to:" section provides a link to the "Software download". The "Journal Article:" section provides a link to "A portable scanning system for evaluation of spray deposit distribution" in Computers and Electronics in Agriculture 76 (2011) 38-43. The "ARS Contact:" section provides a link to "Heping Zhu".

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

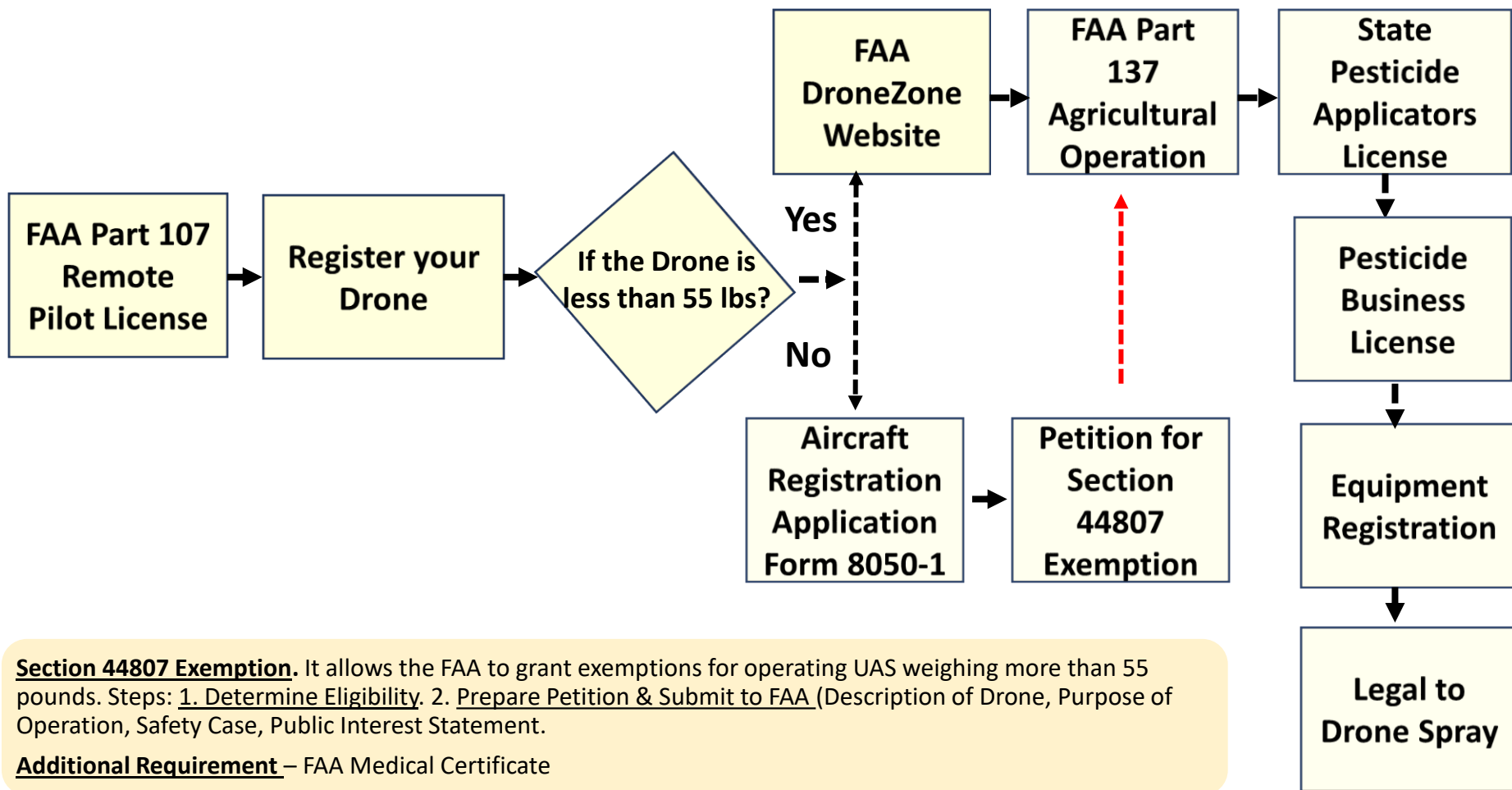
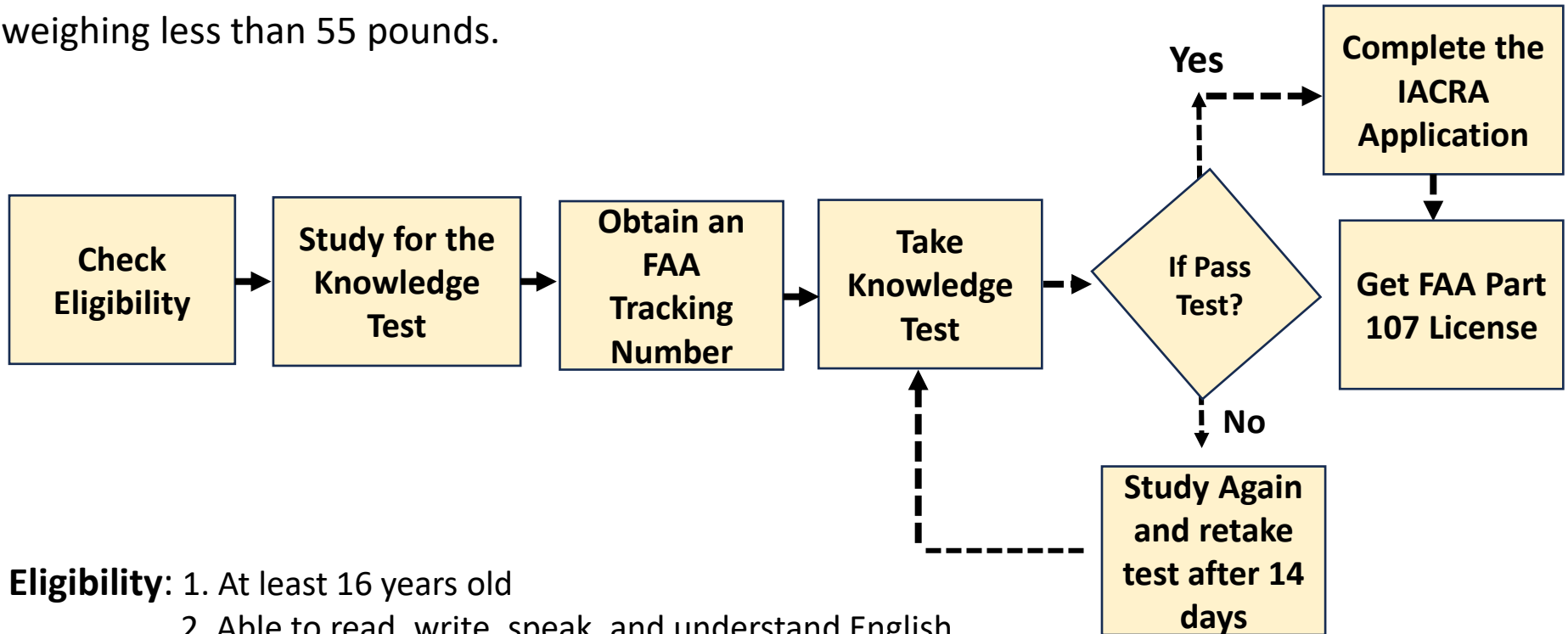


Figure: Steps to Obtain a License for Aerial Spraying Drone Operations in Kansas.

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

AG EDUCATORS SURVEY PARTICIPANTS NEEDED



**Inclusive
Criteria**

**Anonymous
Responses**

**9 Minutes
to Complete**

Help us discover the needs in Kansas Digital Ag & AI

If you are any of the following,
you qualify to take our survey:

- Extension Professional in Ag
- Agriculture Consultant
- Agriculture Educator
- Provide Ag-related Services

Scan Here



K-STATE
Research and Extension

Kansas
Department of Commerce

https://kstate.qualtrics.com/jfe/form/SV_3yOLY0Hxt0KmWDY

Thank you for your Attention !



Any Questions?

Contact : drjoshi@ksu.edu

Cell : 605-592-6834

X: @Deepakrajoshi7

Digital Ag and AI survey

ATTENTION FARMERS

Survey Participants Needed

**Inclusive
Criteria**

**Anonymous
Responses**

**10-15 Minutes
to Complete**



Help us discover the needs in Kansas Digital Ag & AI

If any of the following apply to you,
you qualify to take our survey:

- Row crop production
- Specialty crop production
- Livestock ranching/operation

Scan Here



[https://kstate.qualtrics.com/jfe/form/](https://kstate.qualtrics.com/jfe/form/SV_bwoxVYFC5t10Wge)

[SV_bwoxVYFC5t10Wge](https://kstate.qualtrics.com/jfe/form/SV_bwoxVYFC5t10Wge)