

## AGRICULTURE FORUM FOR TECHNICAL EDUCATION OF FARMING SOCIETY

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### Drones for Insect Pest Surveillance and Management

#### Authors

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## INTRODUCTION

Agricultural drones, also known as Unmanned Aerial Vehicles (UAVs), are remotely controlled or autonomous flying systems equipped with cameras, sensors, GPS and spraying devices. They are increasingly being used in modern agriculture for crop monitoring, pest surveillance, precision spraying, nutrient management and yield estimation.



### Need for Drone-Based Pest Management

Insect pests cause substantial losses in crop yield and quality worldwide. Traditional pest scouting methods are often labor-intensive, time-consuming, and may fail to detect infestations at an early stage. Drones provide a rapid, accurate, and cost-effective solution for monitoring large agricultural areas and implementing timely pest management measures.

### Importance of Drones in Pest Surveillance

Drone-based pest surveillance enables rapid and precise monitoring of large crop areas, allowing early detection of insect infestations and accurate identification of pest hotspots. By reducing reliance on manual scouting and supporting Integrated Pest Management (IPM), drones facilitate timely interventions, minimize unnecessary pesticide

applications, lower production costs, and promote environmentally sustainable crop protection.

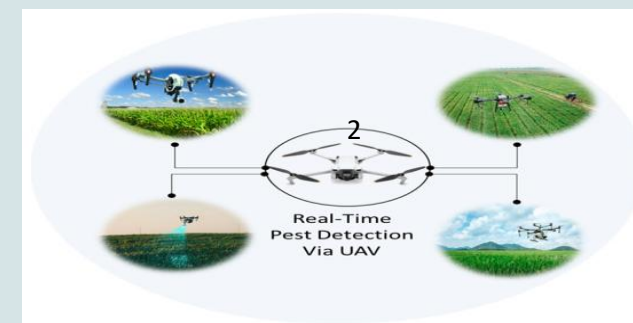
### Key Components of Agricultural Drones

- Flight Platform (Multirotor or Fixed-wing)
- GPS & Navigation System
- RGB, Multispectral & Thermal Sensors
- Data Processing Software
- Precision Spraying System



### How Drones Detect Insect Pest Infestation

Insect infestations cause both visible and subtle changes in plant health, which can be detected early using drone-mounted sensors. High-resolution RGB cameras help assess defoliation, detect leaf damage, and identify pest hotspots, enabling timely and precise pest surveillance before symptoms become clearly visible to the human eye.



## Measure crop reflectance in different wavelengths and help identify

Multispectral sensors detect plant stress, pest-induced damage, and changes in chlorophyll content, while thermal sensors identify temperature variations associated with insect feeding, water stress and early-stage pest infestations, enabling early and accurate pest detection.

## Workflow of Pest Surveillance

Pest surveillance follows a systematic workflow beginning with proper flight planning, where the field area, flight path, altitude, and timing are decided. After this, field scanning is carried out using drones or remote sensing devices to observe crop conditions. During scanning, images of the crop canopy are acquired for detecting visible pest symptoms, damaged patches, or stress signs. These images are then analysed using software, artificial intelligence, or expert interpretation to identify pest presence and severity. Based on the analysis, pest hotspot maps are prepared to show the affected areas in the field. Finally, these maps support decision-making by helping farmers apply pesticides only where needed, reducing cost, pesticide misuse, and environmental pollution.

## Benefits of Drone Surveillance

Drone-based pest surveillance provides real-time monitoring, high spatial accuracy, early warning of infestations, improved pest forecasting, and better decision-making. It has been successfully used for detecting brown planthopper in rice, monitoring fall armyworm in maize, identifying whitefly infestations in cotton, and assessing fruit borer damage in tomato.

## Drones for Precision Pest Management

Modern spraying drones can apply pesticides only where needed, reducing chemical use and environmental contamination.

## Working Principle

- Identifies pest hotspots.
- Generates treatment maps.
- Sprays pesticides precisely on affected areas.

## Advantages

Drone-based pesticide application reduces chemical use by 20-40%, lowers production costs, ensures uniform spray coverage and better canopy penetration, minimizes human exposure to toxic chemicals, enhances operator safety, and enables rapid treatment of large fields for quicker pest outbreak management.

## Typical Drone Specifications

- Tank capacity: 10-40 L.
- Spray width: 4-10 m.
- Flight speed: 3-8 m/s.
- Area coverage: 10-20 ha/day.

## Suitable Crops

Drone technology is widely used in crops such as rice, cotton, wheat, maize, sugarcane, and soybean, as well as in vegetable crops and orchards for efficient monitoring and precision crop management.

## Target Pests

Drones are effective for monitoring and managing a wide range of insect pests, including aphids,

whiteflies, thrips, stem borers, fruit borers, leaf folders and armyworms.

## Advantages of Drone Technology

Drones offer significant economic, environmental, and operational benefits by reducing labour and pesticide costs, increasing productivity, minimizing pesticide drift and environmental pollution, conserving beneficial insects, enabling rapid field coverage, improving monitoring accuracy, and facilitating better record keeping.



## Challenges

Despite their advantages, drones face challenges such as high purchase and maintenance costs, expensive sensors and software, limited battery life and payload capacity, weather dependence, regulatory requirements, and the need for trained operators with expertise in data interpretation and drone management.

## Future Developments

- AI-assisted pest detection.
- Autonomous drone swarms.
- Real-time pest forecasting.

- Integration with IoT and smart farming systems.
- Automated variable-rate pesticide application.

### **Recommendations for Farmers**

- Adopt drones as part of Integrated Pest Management (IPM).
- Conduct regular surveillance flights.
- Use drone data for need-based pesticide application.
- Train operators in drone handling and data analysis.
- Integrate drone technology with weather-based pest forecasting.

### **Role in Sustainable Agriculture**

In sustainable agriculture, these practices play an important role by reducing the misuse of pesticides and encouraging their need-based application. They help improve resource-use efficiency by ensuring the proper use of water, fertilizers, pesticides, and other inputs. This leads to better crop growth and enhanced productivity without excessive dependence on chemicals. At the same time, they minimize environmental impacts by reducing pollution, conserving soil and water quality, and maintaining ecological balance in agricultural systems.

### **CONCLUSION**

Drone technology is transforming insect pest surveillance and management by enabling rapid monitoring, early pest detection, and precision pesticide application. The integration of drones with artificial intelligence, remote sensing, and precision

agriculture tools offers tremendous potential for improving crop protection, reducing production costs, and promoting sustainable agricultural development. As the technology becomes more affordable and accessible, drones are expected to become an integral component of modern pest management strategies in agriculture.