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FLIGHT OF THE FUTURE: HARNESSING DRONES FOR AGRICULTURAL PEST CONTROL

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Introduction

The main cause of the worldwide decrease in food grain output is the biotic stressors brought on by pests and diseases, which are known to inflict enormous harm. There is a need for technological progress in this sector because the conventional methods of applying fertilizer and pesticides take longer and are less efficient. In these situations, it is critical to use plant protection measures in a timely and effective manner. Miniaturized drones, commonly referred to as unmanned aerial vehicles, offer numerous advantages such as high efficiency, decreased labour requirements, extensive coverage, time and energy savings, prompt reaction times, and environmental safety. Even in the agricultural sector, drones are becoming more popular as a way to manage insect problems.

Agricultural Drone

Drones are currently semi-automated machines that are rapidly evolving into fully automated machines. These tools offer a great deal of promise for collecting linked spatial data for agricultural planning. Despite certain inherent obstacles, this technique can be applied to useful data analysis. The drone was first developed as a military tool and went by several names, including Miniature Pilotless Aircraft, Unmanned Aerial Vehicle (UAV), and Flying Mini Robots. These days, it's used in a variety of industries, including business, infrastructure, farming, security, insurance claims, mining, entertainment, telecommunication, and transportation. Small unmanned aerial vehicles (UAVs) are becoming more and more common in agribusiness these days.

Types of Drones

Single Rotor Helicopter Drones

These devices, which resemble miniature helicopters and are powered by either gas or electricity, can be used for mapping erosion brought on by global warming, researching storms, and surveying land.

Multi-Rotor Drones

Multi-rotor drones are becoming more popular for a variety of applications due to their diversity and ease of use. Several rotors are commonly present in them, four in quadcopters, six in hexacopters, or eight in octocopters, which help with stability and control when in flight.

Fixed-Wing Drones

They resemble typical airplanes, but instead of using rotors to generate lift, they have wings, which makes them incredibly effective. Typically, these drones run on fuel rather than electricity.

Fixed-wing unmanned aerial vehicles (UAVs) find applications in the military's attack operations, scientific communities' transportation of bulk equipment, and non-profit organizations' transportation of food and other supplies to remote locations.

Fixed-Wing Hybrid VTOL Drones

Their rotors are mounted to the wings, making them a hybrid of rotor-based and fixed-wing drones. Its hybrid design gives customers the vertical flying capabilities of a rotor-focused design and the durability of a fixed-wing design.

Applications in Insect Pest Management

Drone mediated remote sensing

The employment of drone-based remote sensing technologies in precision insect pest management is appealing due to its numerous advantages. Larger coverage areas can probably be reached by sensing drones than by handheld, ground-based equipment. Specific biotic pressures, such infestations of insects, cause physiological reactions in plants, alter their capacity for photosynthesis, and thus alter the spectrum range of leaf reflectance.

Drone mediated aerial photography

Aerial photography facilitated by drones has made precise agricultural planning and wireless sensor and network clustering possible for plant pest surveillance. When it comes to problem solving, drone technology may provide farmers with an excellent aerial picture of their property and enable them to make critical management decisions. Drone photographs are sent to a cloud data centre where spectrum analysis technology is used to analyze the extent of pest damage.

Drone mediated insect pest sampling

It is possible to use a drone-attachable device to catch flying insects as either freely moving or position-fixed traps that are sufficiently developed to be used for sampling insect pests. A drone is attached to a double-charged dipolar electric field screen, or DD-screen, and the screen creates an electric field between it and the insects that enter it, drawing them in. The electromagnetic field is powerful enough to keep the insects inside the trap after they are caught.

Drone mediated precision application of insecticides

By applying insecticides at different rates, an actuation drone could assist in controlling the pests at agricultural field hotspots. In several parts of the world, new drone models equipped with crop dusters and/or spray equipment are now in development to become commercial drones.

Precision application of pesticides, in conjunction with precision monitoring, may lower the overall number of sprays, which would lower pesticide consumption, inhibit the development of insect resistance, and boost the presence of natural enemies in the field.

Drone mediated precision releases of natural enemies

Drones are becoming a valuable tool for augmentative biological management, which relies on the widespread deployment of natural enemies to eradicate pests right away.

By placing the natural enemies precisely where they are required, they could increase the effectiveness of biocontrol chemicals and lower distribution costs.

Drone mediated Sterile Insect Technique (SIT) and mating disruption

The release of sterile insects is an additional application for drones in pest control. Codling moth populations in the USA, Canada, and New Zealand have been successfully managed through experimental programs utilizing drones to release sterile insects. Additionally, sterile insects launched by drones have been shown to be an efficient pest control method in the USA for Mexican fruit fly and cotton pink boll worm.

Conclusion

A growing number of people are using drones for precise insect pest management. Drones equipped with sensors, sometimes known as remote sensing equipment, are used to map agricultural performance variability, track pest outbreaks, apply insecticides, and release natural enemies in addition to monitoring crop health. A few number of nations, mainly the US, China, Japan, and South Korea, have made commercial use of drones in fields or forests, despite advancements in drone-mediated precision agriculture technologies over the previous ten years. Drone-mediated pest management technologies show a lot of promise and are a great alternative to traditional methods. They should be actively supported in agricultural research and technology development in India and widely encouraged for their efficient application as a component of integrated pest management techniques.