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Unmanned Aerial Vehicle and Its Applications in Integrated Pest Management

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SUMMARY

When monitoring a crop's health and making the necessary decisions to sustain its health, this progressive change is crucial. Unmanned Aerial Vehicles are quite helpful for the task because they can quickly identify issues on the spot and take corrective action. UAVs are being used progressively for pest management, and as they are at the core of the fourth industrial revolution, they have the potential to serve as the catalyst for an IPM change driven by technology.

INTRODUCTION

Food and nutritional security are of utmost importance to the burgeoning population of our country. A significant part of crop production is lost due to insect pest, weeds, diseases, nematodes, rodents etc. The existing management measures for insect pests *viz.*, cultural, mechanical, physical, biological and chemical control have limitations like time, money, human health and drudgery. To overcome them, the convention of technology with agriculture is essential by upgrading towards precision agriculture. One such invention that strives to extend the frontiers of pest management is the utilization of Unmanned Aerial Vehicle (UAV) (Joshi *et al.*, 2022). Through studies it is estimated to create 70 billion euros by 2025 in global economy.

What is a UAV?

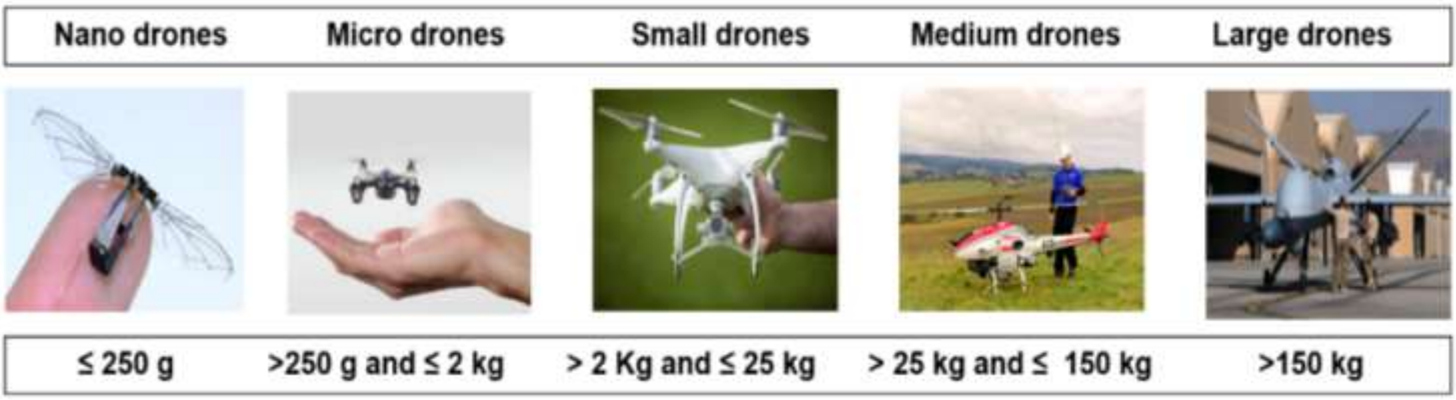
An aircraft without a human pilot on board, it's a type of unmanned aircraft. It is also referred as remotely piloted aircraft (RPA), remotely piloted air system (RPAS), unmanned aerial system (UAS) or uncrewed aircraft system (UAS) most commonly called as Drones- Dynamic Remotely Operated Navigation Equipment (Li and Tang, 2016).

What are the core components of a UAV?

1. Chasis/Frame
2. Propellers
3. Motors and battery
4. Electric Speed Controller (ESC)
5. Flight controller
6. Radio receiver

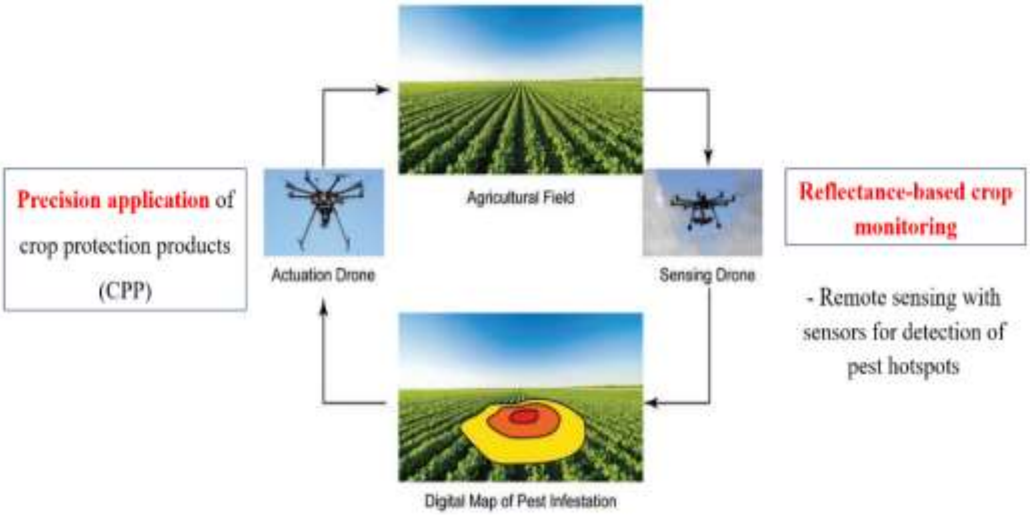
Classification of UAVs:

UAVs are classified based on different criteria *viz.*, wing type, gross weight, flight altitude, endurance, data link range, maximum take-off weight, payload etc. UAVs can be operated remotely either by telemetry or autonomously with pre-programmed pathways using softwares (Li and Tang, 2016).



Drones in Integrated Pest Management:

- Traditional field scouting is expensive & Time consuming
- When pest are small to naked eye, live inside soil or on tall trees.
- Lack of reliable sampling techniques



- Drones that solve this are the Sensing Drones
- While delivering a crop protection product like insecticides, there is always risk to operator and drift losses are prevalent
- And lot of labor is involved which is solved by Actuation drones
- In an agricultural field, sensing drones carry out reflectance-based crop monitoring by remote sensing with sensors to detect the pest hotspots
- Based on these hotspots, crop protection products are precisely applied using actuation drones
- Both sensing and actuation drones could communicate to establish a **closed-loop management solution** that are cost-effective and eco-friendly. As they help in proper decision making, the area where pesticides are applied will be reduced

Sensing drones in IPM:

Softwares used post analyse are mushrooming lately. Few of them are tensorlight, dronebee, agronfly etc. Marston *et al*. (2020) conducted caged experiments in 2017 and 2018 at Rosemount where the whole-plant densities of soybean aphid, *Aphis glycines* Matsumura were recorded along with UAV-based multispectral imagery. The near-infrared reflectance sensors predicted the pest outbreak with an efficiency of 83.4 per cent under caged conditions and NIR decreased with increasing soybean aphid populations in caged and open field trials when cumulative aphid days surpassed the economic injury level.

Actuation drones in IPM:

Its majorly aerial spraying. Downwash effect - In aeronautics, Downwash is the action of changing the direction of air due to the action of the aerodynamic airfoil, wing or helicopter in motion, as part of the lifting process. Solution to topographical problems and human drudgery. Factors affecting are crop canopy, type of pest and composition of spray, area and season, frequency and effects of spray on crop as well as UAV types (Borikar *et al.*, 2022). Valdivia *et al.* (2021) released commercially reared lacewing, *Chrysoperla rufilabris* Burmeister eggs at a rate of 30,000 eggs/ha and sprayed organic-certified insecticides *viz.*, Pyrethrins (Pyganic 5.0 EC, 0.58 L/ha) and Spinosad (Entrust SC, 0.22 L/ha) to manage lettuce aphid, *Nasonovia ribisnigri* Mosley. The drone release of lacewing eggs could reduce aphid population (15.6-150.0 aphids/lettuce head) when compared to the untreated plots (32.1-257.9 aphids/lettuce head) and was on par with the application of foliar organic-certified insecticides (11.77-143.5 aphids/lettuce head).

Yan *et al*. (2021) prepared tiny granules of 0.38-0.55 mm size for UAV application where the in-swath distribution patterns of granules was similar to the distribution of aqueous droplets through UAV spraying. Flight height in the range of 1.5-3.5 m gradually provided a more uniform distribution pattern of deposited granules indicating reduced drift losses. The field experiment demonstrated that granular formulations containing 0.25 per cent chlorantraniliprole + 0.15 per cent emamectin benzoate, or higher concentrations provided better and longer duration control of fall armyworm, *Spodoptera frugiperda* (J. E. Smith) than the aqueous spray formulation at the whorl stage of maize plants.

Advantages:
1. Health Hazard
2. Precision agriculture
3. Wide ranged imagery
4. Accessibility

Limitations:
1. Expensive vehicle cost
2. Calibration constraints
3. Small volume of the liquid tanks
4. Environmental contamination
5. No proper legislative policies
6. Connectivity issue
7. Weather dependency 8. Knowledge and Skill

CONCLUSION

UAVs are increasingly adopted for pest management and being the center of fourth industrial revolution, they can become the fulcrum for a technology-led transformation of the IPM. During the outbreaks of pests, they can deliver swift and precise solutions using CPP - pesticides and natural enemies. As a lot of multidisciplinary research is involved with agronomists, entomologists, ecologists, software programmers and engineers, efforts are needed from drone regulators, banking and non-banking financial corporations, to develop customized UAVs with pest risk assessment and mitigation mechanisms to mainstream UAVs in IPM. And if this will be achieved, UAVs in Pest management will be the NEW NORMAL in NEAR FUTURE

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