Applications of Drone Mounted Sprayer for Weed Management

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The global population of 7.7 billion is expected to reach 9 billion by 2050 which may lead to acute shortage of food (www.fao.org). To overcome this problem there is need to increase in the food production. Major constraints in crop production is nutrients management, pests control and weed management (Ghera, 2013). Weeds are major problem in which grow in agricultural crop and it can reduce crop yields by competing for water, nutrients, light, space, & carbon dioxide which leads to yield losses. The conventional weed control methods- manual, mechanical, chemical & biological are popular in which manual/mechanical method (bare hands, bare held, hand operated, sprayer tools) are best but labour intensive and time consuming. Chemical application is most used technique by manual sprayer and engine operated sprayer. Those having some disadvantage in field like chemical wastage, non-uniformity, labor, crop damage and health issue of farmer. The concept of precision and smart agriculture through application of drone technology solution is imperative (roslim *et al.*, 2021). The role of drone technology in weed management is weed mapping and on spot spraying. Weed mapping is used for the site-specific weed management through different image capturing sensors and image analysis software. The early weed detection by mapping which allows to take immediate action, saves on chemical, reduces cost, benefits the environment, prevents soil nutrient competition, reduces crop stress, improves yield and also the remote pilot aerial system for weed management reduces the physical efforts of farmer along with time saving, reduces labor, improves work efficiency, reduces chemical wastages, getting higher yield and reduce health issue (prabhu *et al.*, 2021).

Drone mounted sprayer

Drone is common name for unmanned aerial vehicles/system. Drone stands for dynamic remotely operated navigation. Drone is a remotely piloted aircraft controlled directly by a human operator via radio link, or with various levels of autonomy achieved by using autopilot technology. Drone mounted sprayer is combination of drone and sprayer unit with sensing cameras.

Working of drone mounted sprayer

The signals will be transmitted from transmitter and it will be received by the receiver in the drone. From the receiver the signal goes to the flight controller where the signal will be processed with accelerometer and gyroscope sensors. The processed signal will be sent to the ESC, which allows the specific amount of current to the motor based on the signal it receives. The propellers are mechanically coupled to the motors so that they rotate and produce thrust. The FPV camera takes current supply from the flight controller and it records the video, the video signals will be processed by the transmitter and it will be received by the receiver in ground. The pump takes current supply from the Li-Po battery and pressurizes the liquid from the storage tank then the pressurized liquid flows through the pipeline and enters the nozzle then gets sprayed. The flow rate of the pump can be controlled by varying the input current which can be controlled by transmitter.

Functions of drone mounted sprayer

1. Spraying of chemical

Drone is equipped with spraying tank in which spraying of chemical done by pumps in which instructed by pilot. It is most commonly used drone mounted sprayer because of less price. Most of drone carry 5 liter to 20 liter of spraying chemical with field capacity of 0.5 ha to 2 ha.

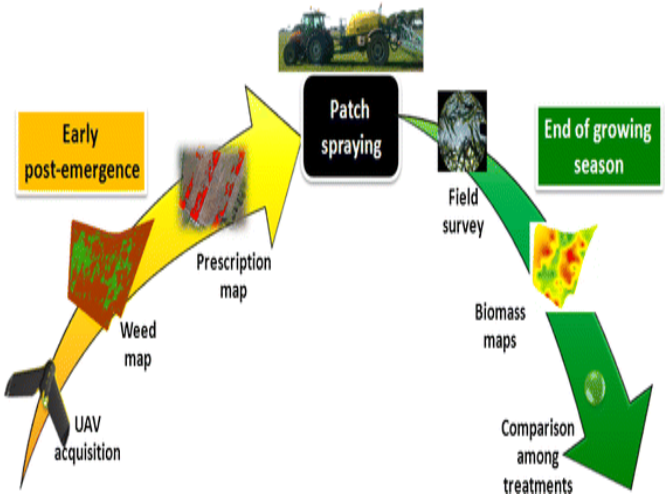
2. Weed detection, mapping and on spot spraying

Weeds grow in the form of patches of crop field. Conventional method weeds detection and weed management is time consuming. The different

patterns of weed appearance within the field require subsequently customized crop management for targeted treatment application. In manual control of weeds and chemical application equipment or sprayer

need more time, labor and herbicide wastage. Overcome this problem special technique called drone equipped with sensors for detection and machine learning software for weed recognition. Sensing equipment and AI are under developed for real time identification of weeds hence enabling site specific treatment with high accuracy. For applying most appropriate dosage of chemical weed mapping is required. The efficient combination of UAV and Sensors system is solution for weed mapping with best image processing software. Different types of sensors used for drone technology are RGB, Infra-red sensors, multi spectral sensors and hyper spectral sensor. Most of software used for weed mapping nothing but Orthomosaiking software – ArcGIS, QGIS, OBIAPIX4D, DroneDeploy, Sentera.

Source: Castaldi *et al.*, (2017)



Advantages of drone mounted sprayer

- Low cost of operation
- High efficiency of work
- Save labour cost
- Reduced health issue
- No damage to crop
- Uniformity of spraying
- Saves chemicals

Limitations

- Flight time and flight area
- Heavy cost for good feature drones
- Safety in operations
- Not suited for very small area
- Knowledge and skill

Challenges

- Extend battery life
- Variety of UAV types
- Research data on reliability is missing
- Weather robust
- Safety issues

Conclusions

The use of remote imagery captured by unmanned aerial vehicles has tremendous potential for designing detailed SSW control treatments in early post emergence. The prescribed maps data transferred to other system for further use. It helps to calculate the herbicide requirements and estimation of the overall

cost of weed management practices. It also helps to repeatable data to analyze field. The saving of herbicide calculated in patch spraying around14 to 39.2% and saves cost of chemical operation. To overcome all problems this technology is best for future generation.

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Table 1: Components of drone mounted sprayer

SI.No	Component	Its function and material use	Picture
1.	Frame	➢ It is a main structure of drone to which all parts get assembled ➢ It is combination of alloys	
2.	Landing gear	➢ It helps for safe landing of drone on the ground ➢ It is made of iron/ steel	
3.	Battery	➢ It is used supply the power to drone of flight controller and pump	
4.	Flight controller & Remote controller	➢ It is helps in the maneuring operations and also it provides auto level function ➢ Transimites and receives the signal ➢ It is an electronic circuit	 

5.	BLDC Motor	➢ It helps to produce RPM to propeller ➢ it is made of carban fiber and wire mesh	
6.	Electronic speed controller	➢ It varies the speed of propeller	
7.	Propeller	➢ It is used to develop thrust to take off and take on of drone ➢ It is made of high carbon fiber	
8.	Tank	➢ It is used to store the liquid ➢ It is made of plastic	
9.	Pump system	➢ To pressure the liquid ➢ It is made of plastic	
10.	Nozzles	➢ It helps to spray the liquid in finer droplets ➢ It is made of plastic	
11	Sensors	➢ It helps to capture the image of ground at high resolution pixels	
12	Camera system & Video system	➢ It helps to transmission of video signal to receiver	

Source: Shaw and Vimalkumar., (2020)

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