DRONES FOR PRECISION WEED CONTROL

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INTRODUCTION

Remote sensing using multispectral aerial imaging has showed potential in creating accurate weed maps, especially during late phenological stages of marijuana. Despite the current high operational costs associated with hyperspectral images, hyperspectral sensors have the capability of capturing hundreds to thousands of precise radiometric bands, primarily in the visible and infrared spectra, and have the potential to yield exceptionally precise weed maps during both early and late phenological stages. Weed map accuracy and resolution are affected by variables such as flight height, speed, camera resolution, and the exact UAV model employed. RGB, multispectral, and hyperspectral cameras are among the sensors available for weed management through drones. Because of their low cost and lightweight construction, RGB cameras are often utilized, although multispectral sensors capture a broader range of spectral bands, allowing for the estimation of a greater number of vegetation indices. Hyperspectral sensors have the ability to capture hundreds to thousands of exact radiometric bands, especially in the visible and infrared spectra, allowing for very detailed weed maps during both early and late phenological stages. When combined with UAVs, these sensors enable site-specific weed management, adding to the long-term viability of agricultural production systems. Furthermore, the use of artificial intelligence (AI) in drones is being investigated in order to detect, identify, and eradicate weeds without drowning the entire crop in pesticides, resulting in more sustainable agriculture.

APPLICATIONS OF DRONE IN WEED CONTROL

- **Weed detection and mapping**: Drones outfitted with modern cameras and sensors can accurately identify and map weed infestations, allowing for site-specific weed treatment.

- **Drone sprayers** may effectively spot spray weeds, insects, and illnesses, lowering the number of acres sprayed by 30 to 50% or more.

- **Fungicide and pesticide application:** Drones can be used to apply fungicides and insecticides more precisely than traditional methods.

- **Autonomous weeding:** Using herbicide spray or mechanical techniques, certain algorithms can be developed to handle weed eradication using autonomous weeding robot systems.

- **Precision weed control with AI**: The use of artificial intelligence (AI) in drones to spot, identify, and kill weeds without drenching the entire crop in chemicals is being investigated, leading to more sustainable and precise weed control.

In addition, research is being conducted to examine the entire workflow, from flying a drone to mapping weed

distribution in the field and using that map to create a spraying prescription for fields. The use of unmanned aerial vehicles (UAVs) and advanced sensors for weed control has the potential to improve the long-term viability of agricultural production systems.

ADVANTAGES OF USING DRONES IN AGRICULTURE

- Drones can speed up weed identification and field location scouting, resulting in a significant reduction in acres sprayed, often by 30 to 50% or more. In some cases, drone sprayers can efficiently spot spray weeds, insects, and diseases, resulting in significant herbicide savings and spraying cost savings.

- Accuracy and precision: Drones outfitted with advanced sensors and cameras have spatial resolutions of less than one centimeter per pixel, allowing for precise and continuous weed infestation monitoring and mapping. This precision enables site-specific weed management, resulting in efficient and environmentally safe weed population control.

- Drones can help farmers map their fields with pinpoint accuracy, allowing them to track the position and health of their crops. This allows farmers to more accurately detect sections of their fields that may require attention, such as patchy areas of dead grass or heavy weed growth, resulting in higher agricultural yields.

- Reduced Environmental Impact: Using drones for weed management can reduce herbicide dispersion, contain herbicide dispersion, and improve biodiversity protection, resulting in less negative environmental impact.

- Drones can cover huge areas quickly, delivering efficient and rapid weed identification and mapping, resulting in time and labor savings for farmers.

- Drone technology is still evolving, and future advancements are likely to bring even more benefits as the technology advances.

These advantages highlight the potential of drones as valuable tools for agricultural weed management, providing increased efficiency, precision, and environmental sustainability.

CONCLUSION

Unmanned aerial vehicles (UAVs) are becoming increasingly popular for managing weeds because of their affordability, adaptability, and ease of use. UAVs outfitted with advanced camera systems with spatial resolutions of less than one centimeter per pixel have proven adequate for weed mapping. The use of unmanned aerial vehicles (UAVs) for Site-Specific Weed Management (SSWM) has been found to be highly effective and environmentally friendly, providing several benefits such as cost reduction in production, weed resistance development mitigation, herbicide dispersion containment, biodiversity conservation enhancement, and reduction of negative environmental impacts. In many nations, site-specific herbicide administration via drones has consistently achieved weed control efficiency over 90%, resulting in significant pesticide savings ranging between 26% and 50% when compared to blanket applications. However, there are still issues in interpreting photos recorded by UAVs with high spatial resolution, particularly in reliably discriminating between soil, weeds, and crops in a variety of environments. Continued research and development efforts are

required to improve the capabilities of remote
sensing technologies for weed detection and
management in agriculture.