Unmanned Aircraft Systems Revolutionizing Mosquito Control Efforts

by Joel Buettner

Unmanned Aircraft Systems (UAS), commonly known as drones, have been described as flying computers that take directions from their human pilots and excel in dangerous, dull, and dirty jobs. This definition distinguishes modern drones from the military specific autonomous aircraft from which UAS originated. As mosquito control professionals, we are familiar with traditional techniques such as searching for mosquito development habitats, locating water under dense vegetation, applying larvicides to specific areas to prevent adult emergence and managing adult mosquitoes to reduce the potential for vector-borne disease transmission. Many of these jobs can be difficult for ground-based equipment and personnel to accomplish effectively. Manned aircraft are often very effective but can be cost prohibitive and present challenges while working in congested areas. UAS technology is a promising answer to better protect the public from mosquitoes and mosquito-borne disease risks.

The entry point into using UAS for many mosquito control agencies is the simple small UAS that has a camera or other sensor payload that can be easily operated and can allow an operator to see mosquito habitat, access routes, or other visual information. Mapping using online services like Drone Deploy can produce 3D maps, and using other payloads like LiDAR or multispectral sensors can help detect terrain features and standing water. Lee County MAD and Collier County MAD have both had success in using sensor technology to help identify precise larvicide application areas that significantly reduce the area to be treated, resulting in effective control. In California, Alameda MAD has used UAS to survey salt marshes and map mosquito habitat, while Placer MVCD has investigated how to optimize operational use of UAS for larviciding in agricultural and non-agricultural areas using a small UAS.

The United States Environmental Protection Agency (EPA) and Centers of Disease Control and Prevention (CDC) joint statement on mosquito control states, "*...the greatest control impact on mosquito populations will occur when they are concentrated, immobile and accessible.*", with the goal to "*[reduce] the need for widespread pesticide application[s] in urban areas*". UAS technology is particularly suited to apply larvicide in a timely manner to where mosquito larvae are concentrated and immobile. This is especially beneficial when ground-based access to these places is difficult or dangerous whether it is replacing older technology like amphibious vehicles or is simply getting into new places.

For mosquito control agencies that use manned aircraft for larvicide applications, UAS may not have the capacity to replace manned aircraft but may help to optimize large treatment areas by being able to apply additional treatments to problem areas or treat areas that are hazardous to manned aircraft such as under powerlines, near towers, or too close to homes or schools. Where manned agricultural aircraft services are unavailable or unaffordable, UAS provides a cost-effective approach to gain some aerial application resources, especially for smaller agencies. How to choose the right UAS to effectively treat the desired size area is a question at the forefront of larviciding with UAS. Large UAS with payload capacities of

Fig. 1. AMCA 1956 Annual Meeting promotional for Beaumont, Texas meeting; Mosquito News 15(3):166-167.

40 lbs. or more is one option to scale up and make larger treatments more efficiently, however, getting too big starts to have diminishing returns in terms of safety, transportation (truck bed vs. trailer) and power requirements. While smaller drones may not have the capacity of their larger relatives, small UAS are generally considered safer by the FAA and are allowed to get closer to structures, roads, and people. Flying multiple small UAS with one pilot is a technique called swarming. This has the potential to allow a ground crew to simultaneously fly several UAS thus increasing efficiency of treatments. A swarm could potentially be of any combination of small or large UAS tailored to a specific mission.

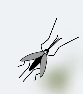
Mosquito adulticide treatments by UAS is an emerging mission type that has the potential to revolutionize how we manage adult mosquitoes. Currently mosquito control insecticides may be applied by UAS if they meet the current manned aerial application requirements, and the application is approved by the registrant. This is a temporary situation until the EPA determines how to evaluate drift and deposition for UAS sprayers. Current methodologies using the AGDISP model is ineffective for multirotor UAS and cannot be used to create UAS-specific pesticide labels. Efforts are currently underway by the AMCA to support the development of a drift model that would be appropriate for aerial mosquito control applications including UAS applications.

UAS equipped with a ULV spray system can apply mosquito adulticides at a range of altitudes and speeds using a powered spray nozzle. Typical heavy-lift UAS airframes that are designed for other types of pesticide applications may be able to carry a ULV system and product provided it falls within the payload limitations. However, mission planning software with the ability to handle the needs of a mosquito adulticide treatment is also necessary. Other variables to consider for a UAS adulticide operation are speed, altitude, and spray cloud droplet size spectrum. UAS move much slower and fly lower compared to manned fixed wing aerial applications making it unlikely that a UAS using fixed-wing manned application parameters would have similar performance. Manned helicopters, however, share some similarities to a UAS except for dramatically different sized rotors and volumes of air movement which would affect the spray cloud. More research and development is needed to understand how ULV applications function with a UAS, how different UAS and spray system combinations affect drift and deposition of the spray cloud.

In addition to the mosquito control UAS missions discussed thus far, new emerging mission types are being devised at a rapid pace. For example, mosquito control and in the structural pest control industries have recently suggested the following:

- Release of sterile insects (mosquitoes)
- Remote deployment and retrieval of mosquito traps in tree canopy to target arboreal mosquito species.
- Application of residual (barrier) applications.
- Application of attractive toxic sugar bait.
- Residential application of lawn care product.
- Roof inspection for rodents and other pest infestations.
- Monitoring for stored product insecticide applications

While the utilization of unmanned aircraft systems for mosquito control holds immense potential, several challenges must be addressed for their widespread adoption. These include regulatory frameworks, public acceptance, operational costs, and technical limitations such as flight time and payload capacity. To overcome these challenges, collaborations between regulatory authorities, researchers, and drone manufacturers are crucial. User communities, such as the AMCA, in cooperation with regulators like the Federal Aviation Administration (FAA) and the EPA need to establish clear guidelines and regulations that ensure the safe and responsible use of UAS in mosquito control operations while addressing related issues such as privacy concerns and pesticide labeling. The AMCA has recently had the opportunity to work directly with the FAA to help pave the way for mosquito control specific regulations and procedures that will help us all use UAS safely, legally, and effectively to protect public health and well-being. Public acceptance and awareness also play a vital role in the successful integration of UAS into mosquito control efforts. Educating the public about the benefits and safety measures associated with drone usage can foster acceptance and encourage support for such initiatives. Furthermore, ongoing research and development efforts should focus on improving UAS capabilities, including extended flight times, increased payload capacity, mosquito control specific spray systems, and enhanced data collection and analysis.



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