

Drone payload and flying speed effects on rotor blades' RPM and traveling pattern for agricultural chemical spraying

ABSTRACT

The sprayed chemicals by drones have been widely reported to be off-targeted and not uniformly distributed. This study aims to evaluate the drone blade's revolutions per minute (RPM) and its travelling pattern at different payloads and flight speeds. The obtained results were used to relate to the potential effects on the quantity and quality of spraying. In a test flight on an area of 1000 m², a hexacopter, Advansia A1 was tested in 6 different flying paths of 56 m length. The drone was set to fly at 5 payloads (10, 8, 6, 4, and 2 kg) and 4 flying speeds (i.e. 1, 3, 5, and 7 m.s⁻¹) combinations. The drone travelling pattern and individual rotor blade rpm at each payload-flying speed combinations were analysed. From the result, the RPM of each rotor blade were found to decrease by 14 to 20% as the payload was decreased from 10kg to 0kg. Thus, in actual spraying activities, the changes in RPM could produce a downwash airflow pattern that continually varies from starting point up to the finishing point that would effect on pesticide's distribution along the flying path. On drone travelling pattern, at higher flying speed, a much lesser time and distance was required for the drone to be stabilized to the targeted speed. This relates to the longer time needed by the drone to accelerate and decelerate. The average real speed of the drone was notably reduced to 0.96, 2.72, 3.83 and 4.05 m.s⁻¹, in which, it was, far less than the initial specified speed set at 1, 3, 5, and 7 m.s⁻¹, respectively. The drone flying pattern during spraying needs to be considered for application rate determination to avoid for the crops to be under or over pesticide applications. The obtained finding is remarkably critical and useful in ensuring the efficiency of agricultural chemical spraying activities using drone.

Keyword: Aerial spraying; Agricultural drone; UAS; Flying behavior; Spraying management