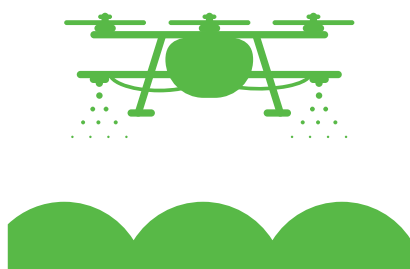


CROP LIFE STEWARDSHIP GUIDANCE FOR USE OF UNMANNED AERIAL VEHICLES (UAVs) FOR APPLICATION OF CROP PROTECTION PRODUCTS

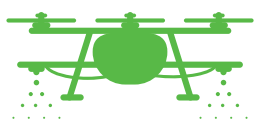


Unmanned Aerial Vehicles (UAVs) are increasingly being used by large- and small-scale farmers. This includes for mapping, crop surveillance and scouting, pesticide application, monitoring irrigation and monitoring grazing livestock.

Their use offers not only substantial labor-saving opportunities, but if handled properly, increased safety in many agricultural situations. With this increasing use comes the need to ensure appropriate stewardship measures are put in place to maximize benefits while minimizing risks.

CropLife International recognizing the importance of stewardship in crop protection have developed 'Guidance for use of unmanned aerial vehicles (UAVs) for application of crop protection products'. This guidance is summarized below.

Benefits of using UAVs for pesticide application include better targeting, as well as lower risk of user contamination. However, risks can include:



- Off-target drift to non-target crops, water bodies and bystanders
- Equipment contamination
- Interference with operator control
- Unregulated use

Increasingly, country regulations require that UAV pilots are trained and certified, but the regulations generally do not stipulate that they are trained in the proper understanding and use of chemicals.

Best management practices (BMPs)

BMPs before application



Read the label

Whenever handling and applying pesticides always read and understand the label before use and follow the instructions.



Know and comply with the relevant laws.



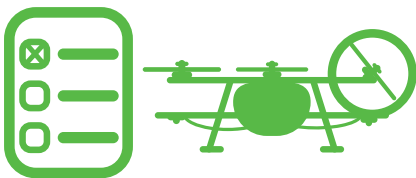
Spray Equipment

Spray Equipment: Before spraying, flush water through the systems to remove residual air bubbles from the and check if any leaks can be identified from damaged connections, hoses, etc. Avoid cross-contamination from previous products (e.g. herbicides) by checking the equipment has been properly wahed after the last use.



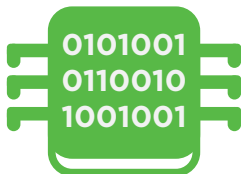
Documentation

Check necessary documentation including UAV registration and license, pest control and/or chemical handling license. If a farmer hires a service to apply pesticides by UAV, they should check that the company being contracted has the appropriate documentation.



UAV fit for flight

Carefully go through the manufacturer's preflight checklist and check every part for signs of damage or obstruction. Ensure that batteries and reserves are adequately charged, and that battery charging equipment is available if required. Check functioning, controller, etc. If the UAV is hybrid or gas powered, ensure that there is sufficient fuel in a container safe to store and transport.



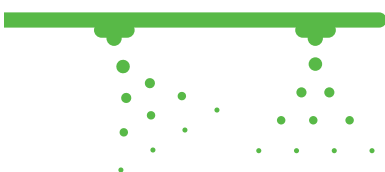
Firmware

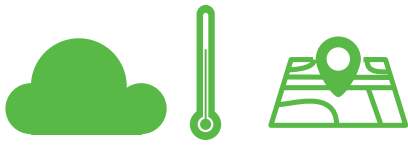
According to the manufacturer's instructions, check the UAV firmware and ensure it is up to date. Ensure that your UAV is always calibrated for connectivity, navigation, and behavior. Check preflight settings e.g. GPS, compass, LED status, satellite locks, gimbal level, and flight controls.



Calibrate Sprayer

Good UAVs will be fitted with an automatic internal-pump calibration system. Test water should be added according to the manufacturer's instruction, the amount and nozzle types entered into the system and the UAV set to run the calibration system on the ground. This should be repeated for a second pump if it is present. Placing graduated measuring cups under the nozzles will allow the comparative outputs to be judged. Any irregularities could mean that nozzles are worn or damaged and need to be replaced. If this is not the case, then there is an imbalance in the system that may require further investigation according to manufacturer's recommendations. It is recommended that low-drift nozzles are used.





Flying conditions and itinerary

Check the weather and temperature. Understand the area to be treated, as well as the surrounding area, including water bodies, other cropping areas, residential areas, and beehives.



Crop and pest targets

The identity of the crop, growth stage and canopy height should be confirmed along with the location of pests and diseases. It is important to check that the nozzles, pressure settings, and formulation are appropriate for delivering the right sized droplets for the job. Only pesticides appropriately registered for use against the target from UAV application should be used.

BMPs for Mixing and loading



Location

Mixing and loading of pesticides should not occur within 120 m of any private or public drinking water supply or within 50 m of surface water. Avoid pesticide spills and prevent back-siphoning into wells or surface water impoundments.



Personal Protective Equipment (PPE)

Those handling pesticides or equipment that will be contaminated should wear the appropriate PPE. For mixing, loading and decontamination of the UAV, this should include long sleeves and long trousers, boots, face protection, chemical resistant gloves, and a chemical resistant apron. When flying the UAV, PPE is not required but it must be used when in contact with the UAV after use and when handling the pesticide concentrates.

BMPs during application



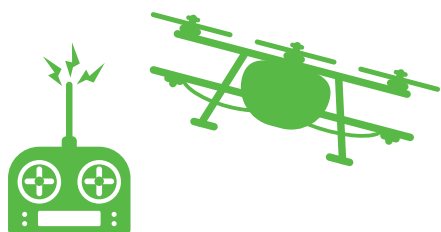
Environmental variables

UAVs may suffer problems at wind speeds in excess of 3 m/sec. Wind speed and direction will also influence flying height. When the wind speed is less than 3m/s, a boom height of between 2 and 3 m above the crop will ensure good lateral movement of the spray. At higher windspeeds, the flying height must be reduced. Fog and mist can decrease visibility which is key to keeping the UAV in line of sight. Applications should only be made during the day.



Bystanders

ensure people and animals do not enter the application area. If they do, stop spraying. Do not restart spraying until they have left.



Loss of control

If control is lost the Return to Home setting should be operated. If the UAV does not return the flight of the drone should be followed (ideally with the use of a Drone tracker, which uses GPS or a cell signal). Verbal warning should be given to people in the vicinity. In the event of a crash, emergency procedures, as described below should be followed.

BMPs for Mixing and loading



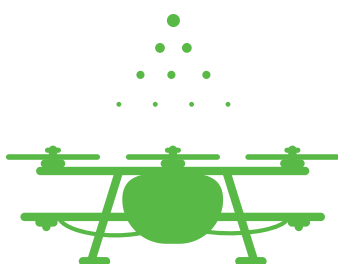
Use of PPE

The appropriate PPE (see above) should be worn by those handling pesticides/pesticide containers or the UAV after use.



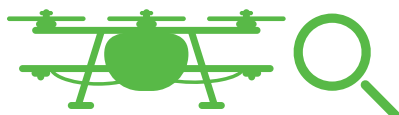
Disposal of empty pesticide containers

Containers should be triple rinsed, punctured and disposed of safely, preferably via an empty pesticide container management program.



Cleaning after use

The UAV should be sprayed with water to decontaminate it, with care taken that the wash-water does not enter drains or water courses or create point source contamination near wells, etc. Three separate washings should be conducted. The tank should be triple rinsed with clean water and the waste disposed of as with the outside wash water. The tank should then be partially filled and sprayed-out on the ground to clean out the pipes and the equipment left to dry.



Mechanical inspections

Once dry, the UAV should be inspected for damage to the rotors, the integrity of pipes, clips and nozzles. Record any issues found.



Documentation

Always keep records of all operations. These should be kept for three years at least or according to local regulations.



UAV transport and storage

The UAV should be transported securely in a separate compartment from any passengers. When not in use, the UAV should be stored in a locked and secure place away from dwelling space for people or animals.

Emergency plan



Identifying hazards

For example, loss of contact, bird-strike, structural failure, battery fire, etc.

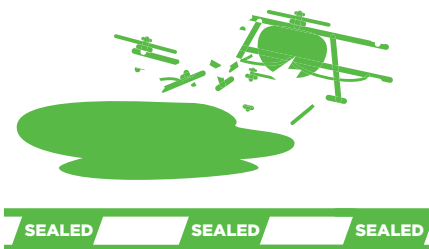


Identifying exposure

Identify who or what might be exposed.

Evaluating the risks and mitigations

Consider the risks created by the hazards and the people, environments or objects that might be exposed. How can these risks be mitigated? What actions need to be implemented by and by whom?



Emergency action

In case of spillage during filling or if a crash occurs the contaminated area should be sealed off and pesticide clean up procedures that are generally described in CropLife International's [Guidelines for the Safe Warehousing of Crop Protection Products](#) followed. These also describe emergency procedures, for example in case of a fire. The operator should have a dry powder or foam extinguisher available. If emergency services are involved they should be informed of the pesticide being used. The above mentioned guidelines also describe procedures to follow in the event of human contamination with pesticides.