Unmanned Aerial Vehicle (UAV) or Remotely Piloted Aircraft (RPA) technology is growing rapidly and the capabilities and quality of the equipment continues to increase. The use of UAVs for the application of pesticides began in rice and vegetable fields in Japan with mini-helicopters in the 1990s and has now grown with the addition of 4, 6 and 8 rotor battery-powered UAVs. The technology is well-suited to small plots and rice paddies where there are considerable advantages both in the speed of the operation and the decreased possibility of operator exposure.

Currently the Australian Pesticides and Veterinary Medicines Authority (APVMA) considers that pesticide application by UAV or RPA is covered by the July 2019 Spray Drift Policy and the spray drift definition of 'aircraft': *"An 'aircraft' is a fixed-wing or rotary aircraft that applies spray in-flight. This includes unmanned aerial vehicles (UAVs). This excludes application equipment defined as a 'boom sprayer' or 'vertical sprayer' or when the product is used for any use pattern not requiring a spray drift risk assessment."*

Given the APVMA considers that UAV application is covered by the above definition, this is de facto registration for drone application of pesticides registered for aerial application. The APVMA further recognises that risk to operators, bystanders and the environment, as well as risk mitigation measures associated with UAV application, will require specific consideration if holders wish to include specified recommendations for application by UAV on their product labels.

This means that a product assessed and registered for aerial application is also considered registered for UAV application, so long as the label instructions for aerial application, including spray volume, buffer zones, etc., can be adhered to. If the holder wishes to deviate from the registered instructions for aerial application and include specific guidance for UAVs, then an application to the APVMA for assessment is required.

Whilst it may be convenient that products registered for aerial application can also be applied through UAV equipment, many products will not have been tested through this equipment (which has a variety of spray delivery mechanisms available) and successful spray application can be somewhat of a lottery. Importantly, like the label language adopted for aerial spray application and ground-rig spray application, adoption of UAV equipment for spray application should also be accompanied by standardised label language to ensure uniform understanding across the industry sectors.

The proposed official CropLife policy position is that the APVMA should enable and allow registration holders to determine their own product restrictions regarding UAV Application. This includes allowing label statements such as 'This product has not been tested for use though UAVs and therefore its use though this equipment cannot be supported'. Further, that the Agricultural Labelling Code should be amended to include a suitable standard label phrase to specifically communicate the disallowance of applications by UAVs, despite having registration for applications through aerial equipment. For example

This product has been assessed and is registered for application by piloted fixed and rotary wing aircraft ONLY. Application by Unmanned Aerial Vehicle (UAV) or Remotely Piloted Aircraft (RPA) has been assessed as unacceptable and is not registered for that use. DO NOT apply this product through unmanned aerial vehicles of any type.

Alternately, holders may wish to define the UAV equipment through which application of the product is acceptable, including specification of make, model and spray delivery platform/equipment.

Current UAV models, though much cheaper than conventional mechanised ground and aerial spray equipment, are limited in the payload that they can carry and their flight time. This means that current UAV equipment is advantageous for treating small units of land but flying as single units is uncompetitive with conventional equipment for treating larger cropping areas. One solution currently being utilised in other parts of the world involves the deployment of UAVs in a swarm under the control of a single operator. There are issues with the deployment of this technology for civilian use due to its potential for misuse, or accident. Additionally, there are a number of experimental UAVs that carry much larger payloads that may be more competitive over larger acreages.

The specifications of both these larger and ” swarming” UAVs, however, have resulted in their being listed on the Defence and Strategic Goods List (DSGL). DSGL Item Details - 9A112 specifically addresses both *autonomous flight control and navigation capability, and incorporating an aerosol dispensing system/mechanism with a capacity greater than 20 litres.* Importers of UAV equipment that may fall into these classifications should assess and ensure that they are compliant with Australian law.

In Australia, the use of drones is covered by the Civil Aviation Safety Authority (CASA), including registration of larger units and basic licensing requirements for commercial operators and pilots. CASA regulations do not specifically take into account the risks associated with pesticides other than prohibiting the dropping or discharging of things from unmanned aircraft in a way that creates a hazard to another aircraft, person or property.

A range of exemptions are granted to very small drones (<2 kg), which are not likely to be employed to carry a pesticide payload. However, exemptions for small and medium drones (2-25 kg and 25-150 kg respectively) exist for non-commercial agricultural operation of an unregistered drone on the operator's private land, indicating that these applications are exempt from oversight.

The application of pesticides from UAVs is regulated by state and territory control-of-use legislation, which varies in some specifics, but all reciprocally recognise interstate certification and licensing. At minimum, all mandate that UAV applications must be in accordance with CASA requirements and the operator must possess the relevant state licence. Each state's requirements indicate Spraysafe® Pilot Accreditation (or equivalent) from the Aerial Application Association of Australia, OR both AHCCHM307 (Prepare and apply chemicals to control pest, weeds and diseases) and AHCCHM304 (Transport and store chemicals) certification is required before a licence may be granted. Unlike the Spraysafe® accreditation, these modules do not contain any specific requirement to understand aerodynamics and droplet behaviour for aerial application.

Victoria regulations
New South Wales regulations
Queensland regulations
Western Australia regulations
South Australia regulations
Northern Territory regulations

In the event of loss of connection with the pilot, the operator must know what the UAV's programmed procedure is, usually, stopping, hovering and marking its position on GPS or landing. CASA regulations further require UAVs be flown no more than 120 metres above the surface over which they are travelling, must be at least 30 metres away from other people, must always be within visual line-of-sight and can only be flown one-at-a-time. UAVs used for work (commercially) carry extra regulations as above, requiring the operation to be licensed, accredited and operating a registered UAV.

In the event of a catastrophic failure due to equipment malfunction or bird-strike, the operator should have a clean-up and recovery plan already prepared and available. Comprehensive pilot training and certification should address such instances.

The potential decrease in operator exposure from backpack spraying and efficiency savings in treating small fields or infested areas can offer substantial benefits. With future developments in technology that are imminent, UAVs have the potential to lower the costs and risks in smallholder agriculture, for operators and the environment. Additional benefits could include contribution to sustainability goals with benefits for people, the environment and the profitability of agriculture, through more targeted applications resulting in less active ingredient being applied to a unit area. With the advent of UAVs with the capacity to carry larger payloads and/or the careful introduction and approval of swarm technology, UAVs have the capacity to move fully into mainstream commercial agriculture, successfully augmenting commercial ground rigs, rotary wing and fixed wing piloted aircraft. This could enhance both speed and efficiency of coverage, as well as efficacy and safety.

New opportunities have arisen in precision agriculture and environmental land management where UAVs can be directed to treat infected locations only, considerably reducing the amount of pesticide needed, which can help to meet sustainability goals and reduce application to non-target areas.

UAVs are suitable for most crops grown outdoors and are particularly useful in small fields and in water-logged conditions, for example rice. The use in vineyards is also promising, as world-wide there are many small plots that are grown on steep slopes that are difficult to access for many vehicles and often require specialised wheeled vehicles that are more expensive than UAVs.

Though it is expected that drift from UAV applications should be somewhere on the continuum between ground and aerial application, there remains a dearth of deposition work and vortex generation stemming from the variation in sizes, styles and number of rotors per unit. This leads to imprecision about the buffer zones required to protect bystanders and sensitive environmental areas, such as water courses or adjacent crops and habitats. In the future, the continuous improvement in UAV technology may lead to a situation whereby spray droplet deposition from these machines is sufficiently managed to the point they are comparable to the best ground application equipment available.

Penetration of spray mist into the canopies of tree crops is normally achieved by ground-based equipment with blowing equipment providing high velocity air movement, which results in enhanced potential for drift. Whether UAV applications can achieve the penetration needed for this application is as yet unresolved. UAVs are competitive with manual backpack spray equipment in all outdoor situations, including for spot-spraying in areas not compromised by buildings, trees, fences or powerlines, significantly reducing the potential for operator exposure and increasing the area that can be treated. There are potential efficiency advantages with UAVs in spot-treatment for vector control and Right-of-Way vegetation control, however, in fields of > 50 ha, conventional ground and aerial applications will likely remain quicker, and both more efficient and cost effective than UAVs until larger machines or swarming technologies become mainstream.