



Best Management Practices

Application of Aerially Registered Herbicides Using Spray Drones (RPAS)



1. Purpose and Scope

This BMP provides guidance for using Remotely Piloted Aircraft Systems (RPAS) as an aerial application platform for Envu herbicides that have PRD-approved aerial use directions. It focuses on application quality outcomes linked to aerial label intent, including uniform coverage, drift mitigation, and dose delivery. This is a stewardship-focused document intended to supplement PRD-approved product labels and applicable regulatory requirements. The pesticide label remains the legal document and must be followed.

2. Appropriate Use Scenarios

RPAS should be considered an aerial application tool suited to specific operational scenarios rather than a universal replacement for ground or conventional aerial applications. Situations where RPAS may provide operational advantages include:

- Limited ground access (e.g., sensitive terrain, rough topography, or difficult-to-access areas)
- Smaller or targeted treatment areas requiring precision placement
- Sensitive areas where minimizing vegetation disturbance is required
- Time-sensitive applications where access to conventional aerial services is constrained

3. Envu Stewardship Alignment with Aerial Labels

Where RPAS use is permitted by Canadian authorities, Envu stewardship expects operations to follow label directions applicable to aerial application unless otherwise specified by a regulatory authorization or specifically outlined in the label.

Core aerial label concepts that translate directly to RPAS include:

- Uniform application
- Adherence to spray quality requirements
- Drift mitigation
- Recordkeeping

Provincial requirements for pesticide application using RPAS may vary across Canada and may change over time. Applicators are responsible for verifying current provincial authorization, licensing, certification, and operational requirements before conducting pesticide applications using spray drones.

4. Equipment Types and Why They Matter

4.1 Hydraulic Nozzles vs. Rotary (Centrifugal) Atomizers

Spray drones commonly use either hydraulic nozzles or rotating centrifugal (rotary) atomizers. These systems differ in how droplets are generated and how easily droplet size can be adjusted.

Hydraulic nozzle systems (high-level characteristics):

- Pros: low cost; strong penetration under pressure; can be configured for lower drift at appropriate settings.
- Cons: droplet spectrum can be less uniform; nozzle blockage risk can be higher for some formulations; pressure may be less stable depending on the platform.

Rotary/centrifugal atomizer systems (high-level characteristics):

- Pros: droplet size can be adjusted by atomizer rotational speed; droplet spectrum can be more uniform; good applicability across formulations; simpler maintenance for some designs.
- Cons: higher cost; component wear can be higher depending on design; small-droplet settings can increase drift risk.

4.2 Platform (Drone Model) Differences

Spray deposition and drift are affected by platform-specific aerodynamics (rotor number, rotor diameter, take-off weight/payload, and airflow/downwash), plus nozzle/atomizer placement and boom configuration. Because of this, pattern testing and ESW verification should be considered platform- and configuration-specific.

4.3 System-Level Considerations for RPAS Performance

- Application performance depends on the full operating system (aircraft, operator, battery management, refill process, staging, and support), not solely the RPAS platform
- Inefficiencies in logistics (e.g., refill delays, battery limitations) may impact application consistency and adherence to labelled rates

5. Droplet Size / Spray Quality (Practical Stewardship)

Droplet size affects both drift potential and coverage. Coarser droplets generally reduce drift risk but may reduce coverage uniformity on contact targets. Labels and authorizations may specify minimum droplet size categories.

5.1 Droplet Size Categories (VMD) and Typical Nozzle Types

Classification	Micron Range (VMD)	Typical Nozzle Types
Ultra Fine	< 60 µm	Hollow cone (high pressure), mist nozzles
Very Fine	60 - 145 µm	Hollow cone, twin fan
Fine	146 - 225 µm	Standard flat fan (high pressure), twin fan
Medium	226–325 µm	Standard flat fan (normal pressure), extended range

5.1 Droplet Size Categories (VMD) and Typical Nozzle Types (cont.)

Classification	Micron Range (VMD)	Typical Nozzle Types
Coarse	326–400 μm	Air induction flat fan, low drift
Very Coarse	1401–500 μm	Air induction, turbo TeeJet
Extremely Coarse	> 500 μm	Flood jet, boombuster

Note: VMD = volume median diameter. Categories may be referenced in labels or standards (e.g., ASAE/ASABE spray quality classifications).

5.2 Canada-facing operating constraints often discussed for RPAS

Where included in label language or proposed label language, constraints may include:

- Maintain required spray buffer zones and do not apply if they cannot be maintained.
- Do not apply above specified maximum altitude above canopy and maintain consistent speed/height to support uniform deposition.
- Avoid dead calm, gusty winds, rain, and apply below specified wind-speed limits at flying height.
- Do not apply with droplets smaller than the minimum droplet size category specified (e.g., medium or coarse, depending on label).

6. Pattern Testing and Effective Swath Width (ESW)

Pattern testing is used to understand how spray deposits across the flight line (transverse direction) and to determine effective swath width (ESW). ESW is a fraction of total (visible) swath width and is selected to balance uniformity and efficiency. Pattern testing is recommended whenever application parameters or configurations change.

6.1 Field Layout for Swath Measurement (Example)

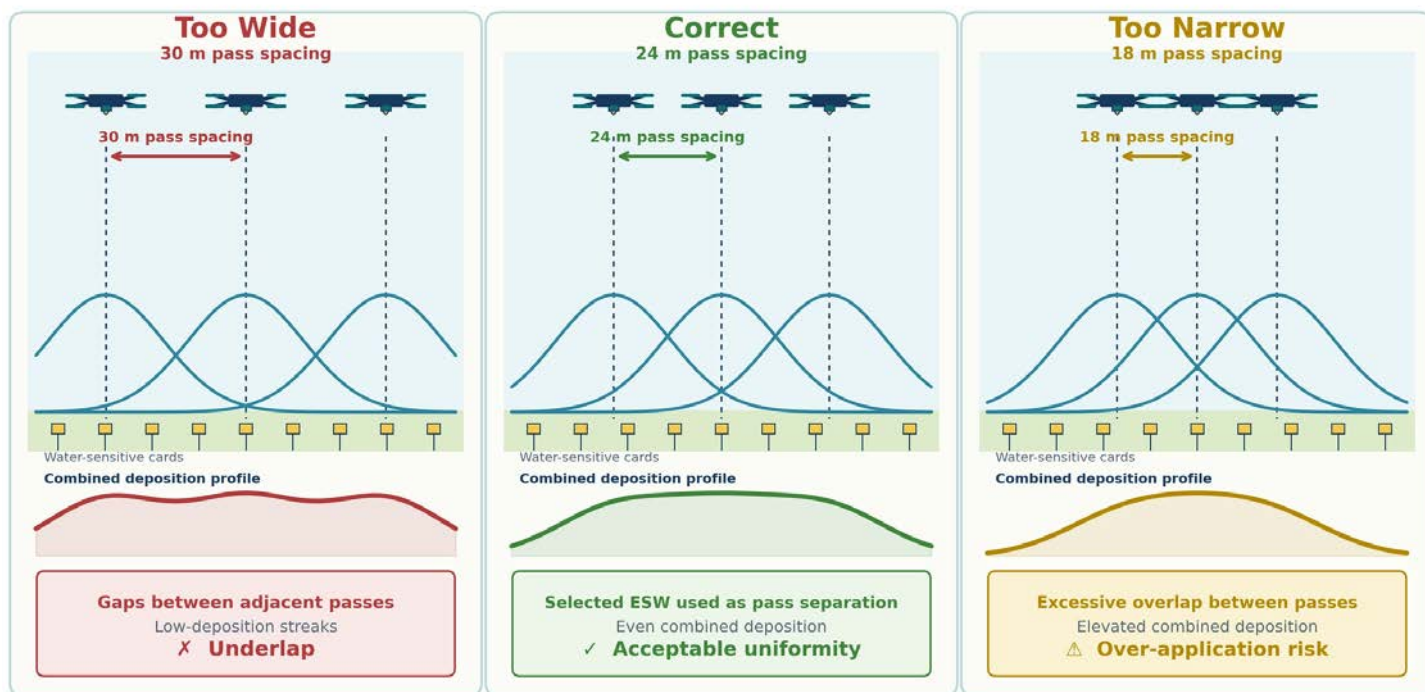
A common approach is to place water sensitive paper across the expected swath to capture a single-pass deposition pattern.

- Use water sensitive paper; spacing between cards can be 25–100 cm depending on desired accuracy.
- Place cards perpendicular to the flight direction across and beyond the expected swath.
- Conduct test passes using the intended settings (height, speed, nozzle/atomizer settings). medium or coarse, depending on label).

6.2 Media, Dye, and Image Capture

Depositions can be measured using multiple sampler types and image analysis approaches.

- Samplers may include water sensitive cards, kromekote paper, mylar cards, or paper receipt tape.
- Water alone will stain water sensitive cards; dyes (e.g., FD&C Blue, Rhodamine, Pyranine) can help visualize stains on other samplers.
- Capture images using a digital camera or scanner; software or mobile apps (e.g., DropLeaf, DropScan, Dropflight, SnapCard) can extract coverage data.



Pass spacing is verified using deposition measurements. The selected ESW should provide acceptable uniformity without gaps, streaking, or excessive overlap.

6.3 Calculating ESW Using Coefficient of Variation (CV)

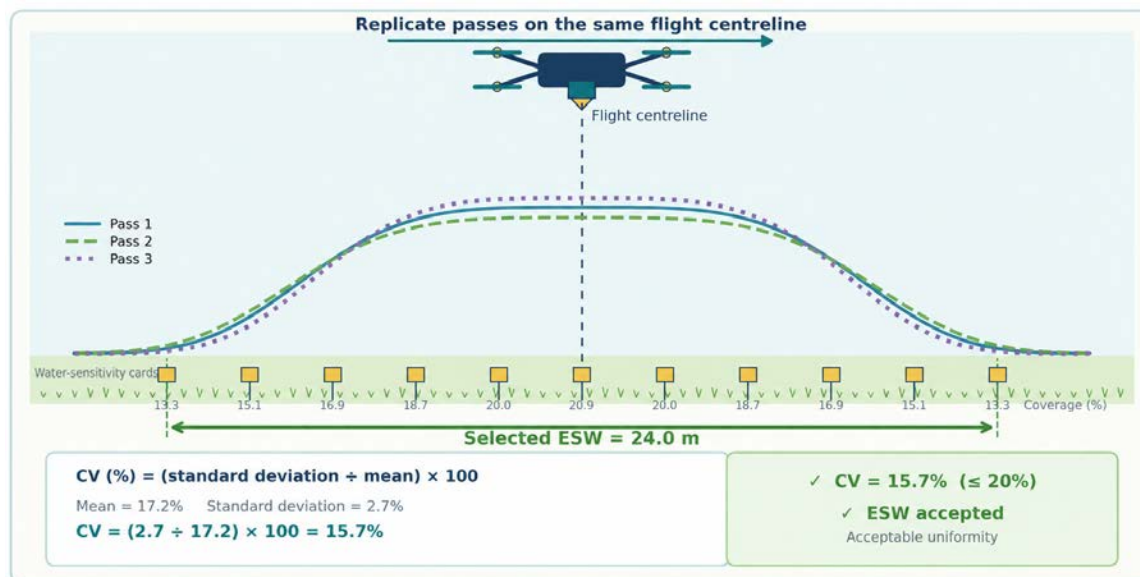
Once coverage (or deposition) is expressed as a function of distance from the flight centerline, ESW can be selected by evaluating uniformity across overlapped passes using coefficient of variation (CV).

- For a selected swath width, compute the mean and standard deviation of coverage across the cards included in that swath.
- $CV (\%) = (\text{standard deviation} \div \text{mean}) \times 100$.
- A common stewardship threshold described in UASS guidance is selecting the largest swath where CV is $\leq 20\%$.
- Because overlap is used to reduce variability, ESW should be paired with a lane spacing (pass separation) that achieves acceptable uniformity and avoids streaking.
- For further information on drone calibration and swath-width assessment, visit <https://sprayers101.com/calibrate-drone/>

6.4 Deposition Verification Frequency

Verification passes are recommended as part of calibration and quality assurance. Use water sensitive paper; spacing between cards can be 25–100 cm depending on desired accuracy.

- Verify deposition by making one pass with water (or food-grade dye) and confirming coverage and deposition are uniform.
- Repeat verification at least three times when establishing a calibration setting.



Example values shown for illustration.

7. Application Rate Calibration (Drone-Specific)

Aerial label intent requires delivery of the labeled rate per hectare. For drones, application rate depends on flow rate, speed, and effective swath width.

7.1 Application Rate Formula (L/ha) and Worked Example

Application rate (AR) can be calculated using:

AR (L/ha) = Flow rate (L/min) ÷ Area sprayed per minute (ha/min).

Worked example (from UASS BMP guidance):

- Flow rate = 5 L/min
- Flight speed = 21.6 km/h
- Effective swath width = 6 m
- Calculate area sprayed per minute (APM): $APM = (\text{speed} \times \text{swath}) / 600 = (21.6 \times 6) / 600 = 0.216 \text{ ha/min}$
- $AR = 5 / 0.216 = 23.15 \text{ L/ha}$ or 2 gallons per acre

Note: Operational planning should consider total system productivity across a working period (including refill and battery logistics), not only active spray time, to ensure timely and complete application of labelled rates

7.2 Alternate Speed Relationship (Manufacturer/Regional Formula Example)

Some guidance expresses operating speed as a function of nozzle flow, desired volume rate, and spray width:

$$V = (Q \times 10000) \div (q \times D \times 60)$$

Where: q = water volume per hectare (L/ha); Q = total nozzle flow rate (L/min); V = speed (m/s); D = spray width (m).

8. Operating Parameters (Height, Speed, Swath Spacing)

8.1 Height

Height affects both deposition and drift. Keep height consistent and as low as practical while maintaining acceptable pattern uniformity.

- Example operational guidance often used for drones: 1.5–4 m above crop canopy, depending on crop/target and platform.
- Example stewardship language for Canada-facing RPAS label: do not apply from an altitude greater than 4 m above the target canopy.

8.2 Speed

Speed affects coverage, swath behavior, and applied volume per area.

- Example operational guidance for drones (row crops): operating speed ≤ 7 m/s (manufacturer guidance may vary).
- Increase in speed often comes with a trade-off in coverage and drift management; maintain consistent speed to support uniform deposition.

8.3 Swath Spacing / Lane Separation

Lane separation should be set based on ESW, **not** advertised swath width. ESW changes with nozzle/atomizer type, height, speed, and platform.

9. Differences in Drone Models (What to Validate)

When moving between platforms (or materially changing configuration), validate:

- Deposition pattern and ESW (pattern test).
- Droplet size category at the operating setting (nozzle/atomizer and pressure/RPM dependent).
- Drift / near-field deposition where required by authorization or stewardship (e.g., marker papers downwind).
- Nozzle/atomizer clogging risk and compatibility for WG/WP formulations (consider physical compatibility checks).

10. Documentation and Records

Record keeping supports compliance and stewardship. Recommended records include:

- Pilot certification and pesticide applicator license/endorsements (as applicable).
- Drone model, configuration, nozzle/atomizer type, number and placement.
- Operating parameters: height, speed, ESW/lane spacing, spray volume, droplet size category, and weather conditions (wind, RH, temperature).
- Calibration and verification results, including pattern test photos/outputs and ESW calculations.



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