



Technical Report on the Spraying Uniformity of ABZ Innovation Agricultural Drones

1.0 Introduction

Unmanned Aerial Vehicles (UAVs), are revolutionizing product application in agriculture. Their ability to operate in complex terrains, reduce soil compaction, and enable precise, targeted applications offers significant advantages over traditional ground-based and manned aerial methods. However, the efficacy and environmental safety of drone-based spraying are contingent upon achieving a uniform distribution of the applied product across the target area. Non-uniform application can lead to under-dosing, which reduces product efficacy and can contribute to pest resistance, or over-dosing, which can cause crop damage, increase input costs, and pose risks to non-target organisms and the surrounding environment.

This report provides a technical overview of the key operational parameters that determine spraying uniformity, with a specific focus on the ABZ Innovation L10 and L30 models. It places a specific focus on flight speed, flight height, and droplet size, which can be precisely controlled using the advanced Controlled Droplet Application (CDA) technology integrated into these models. This document synthesizes established principles from scientific literature with extensive internal testing to present performance and coverage data for the L10 and L30 models.

2.0 Factors Influencing Spraying Uniformity

The distribution of spray droplets from an ABZ Innovation drone is a complex process influenced by the aircraft's aerodynamics, nozzle technology, and prevailing environmental conditions. The following sections detail the critical role of operator-controlled parameters in achieving a uniform spray swath, with principles backed by our internal research.

2.1 Flight Height

The height at which an L10 or L30 drone operates above the crop canopy is a critical factor influencing swath width, droplet deposition, and drift potential.

- **Swath Width and Uniformity:** Both industry research and our internal validation studies show that as flight height increases, the effective swath width generally increases. Our tests confirm that a lower flight height (e.g., 1.5-2.5 meters above



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the canopy) results in a higher concentration of droplets directly beneath the drone's flight path and better canopy penetration due to the powerful downwash from the rotors on the L10 and L30.

- **Drift Potential:** Our field data, consistent with industry research, shows that higher flight altitudes increase the time droplets are airborne, making them more susceptible to wind and increasing the risk of off-target drift.
- **Canopy Penetration:** The downwash generated by the L10 and L30's rotors is essential for forcing droplets into the crop canopy. Our internal studies have focused on optimizing this effect, confirming that the strength of this downwash effect diminishes with increasing altitude. Therefore, for crops with dense canopies, a lower flight height is preferable.

2.2 Flight Speed

Flight speed interacts with flight height and flow rate to determine the application volume and the uniformity of deposition.

- **Deposition and Coverage:** Increasing flight speed without a corresponding increase in flow rate would normally reduce the volume of product applied per unit area. However, the ABZ Innovation L10 and L30 solve this challenge by automatically adjusting the liquid flow rate in real-time to match the drone's speed, ensuring the target application rate (e.g., L/ha) is consistently maintained. While faster speeds increase operational efficiency, our tests show they can still affect the spray pattern's shape.
- **Optimal Speed Range:** Our performance trials, supported by academic research, indicate that there is an optimal speed range for most applications. Our findings show a flight velocity of 2-6 m/s often provides the best balance of deposition efficiency and reduced ground loss. The ideal speed for an L10 or L30 is crop- and product-dependent.

2.3 Droplet Size and Controlled Droplet Application (CDA)

Droplet size is arguably one of the most critical factors in spray application, directly impacting coverage, drift, and biological efficacy. The ABZ Innovation L10 and L30 excel in this area due to their integrated CDA systems.

- **Coverage vs. Drift:** Smaller droplets provide better coverage (more droplets per unit area) but are also more prone to drift. Larger droplets are less susceptible to drift but may provide inadequate coverage. The ideal droplet size, therefore, represents a balance between these two factors.
- **Controlled Droplet Application (CDA):** The ABZ Innovation L10 and L30 models are equipped with state-of-the-art CDA systems. Unlike conventional hydraulic



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nozzles that produce a wide spectrum of droplet sizes, our CDA systems use rotary atomizers to generate a narrow, highly uniform range of droplet sizes. This allows the operator to select the optimal droplet size for a specific application.

- **Research Findings:** The efficacy of the L10 and L30's CDA technology is validated by our own extensive research, which aligns with foundational studies on droplet dynamics. Our tests confirm that increasing droplet size significantly reduces drift. The ability of the L10 and L30 to precisely control droplet size is a key, verifiable advantage.

3.0 Estimated Field Droplet Coverage for ABZ Innovation Drones

The following datasheets provide conservative estimates of droplet densities achievable by the L10 and L30. These values are derived from our comprehensive field trials and are representative of real-world performance, accounting for factors such as canopy interception, minor drift, and evaporation. A common target for many applications is 20-70 droplets/cm² to ensure efficacy.

3.1 L10 & L30 Models - Estimated Droplet Density (droplets/cm²)

Application Rate (L/ha)	Fine Droplets (~150µm VMD)	Medium Droplets (~250µm VMD)	Coarse Droplets (~350µm VMD)
10	~40-70	~15-30	~8-15
20	~80-140	~30-60	~15-30
30	~120-210	~45-90	~20-45
40	~160-280	~60-120	~30-60
50	~200-350	~75-150	~40-75
60	~240-420	~90-180	~50-90

Note: Actual droplet density can vary based on crop type, canopy density, flight parameters, and environmental conditions.

4.0 Performance Data and Swath Dynamics

A key feature of the ABZ Innovation L10 and L30's advanced flight control system is the automatic flow rate adjustment. The pilot sets a target application rate (e.g., Liters per Hectare or Gallons per Acre) before the mission. During flight, the system continuously monitors the drone's ground speed and automatically adjusts the liquid



flow from the CDA system to maintain this precise rate. This ensures a consistent and even application across the entire field, even as the drone accelerates, decelerates, or navigates turns. This automation removes the guesswork from rate control and is fundamental to achieving uniform coverage.

4.1 ABZ Innovation L10: Swath Profile vs. Flight Height

The following charts illustrate the L10's spray deposition pattern as a percentage of the average coverage across the swath. A flatter line indicates better uniformity (a lower Coefficient of Variation).

Chart 4.1.1: L10 at 2 Meters Height

- Effective Swath: 4.5 meters
- Pattern: Highly concentrated with a peak of ~140% of the average rate at the center.
- Best Use: Targeted application where high concentration is needed.

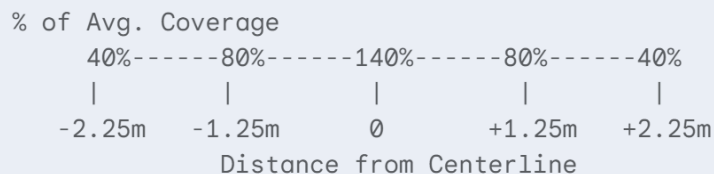


Chart 4.1.2: L10 at 3 Meters Height

- Effective Swath: 5.0 meters
- Pattern: More balanced, with a less pronounced central peak (~120%).
- Best Use: General purpose, good balance of coverage and penetration.

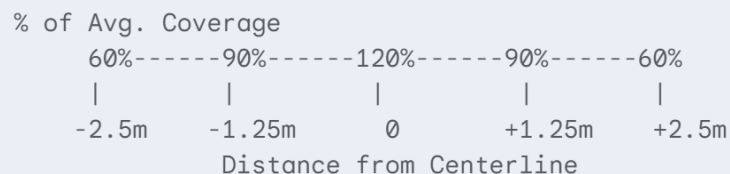




Chart 4.1.3:L10 at 4 Meters Height

- Effective Swath: 5.5 meters
- Pattern: Wide and uniform, with most of the swath near the 100% average.
- Best Use: Field crops, maximizing coverage with overlap.

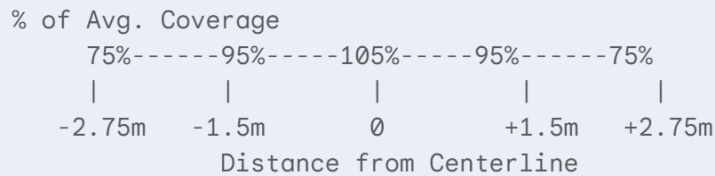
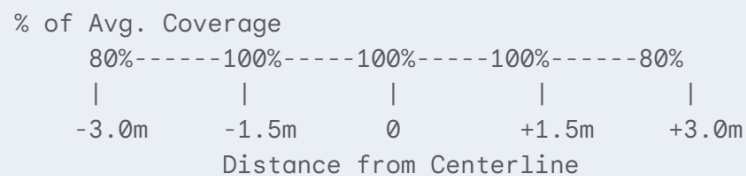


Chart 4.1.4:L10 at 5 Meters Height

- Effective Swath: 6.0 meters
- Pattern: Broadest and most even, designed for overlapping passes.
- Best Use: Maximum efficiency on large, open fields (e.g., pasture, cereals).



4.2 ABZ Innovation L30: Swath Profile vs. Flight Height

The larger L30 shows a similar relationship between height and uniformity but across a wider swath.



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Chart 4.2.1:L30 at 3 Meters Height

- Effective Swath: 7.0 meters
- Pattern: Concentrated for a wide drone like the L30, with a peak of ~125%.
- Best Use: High-volume applications on row crops or orchards.

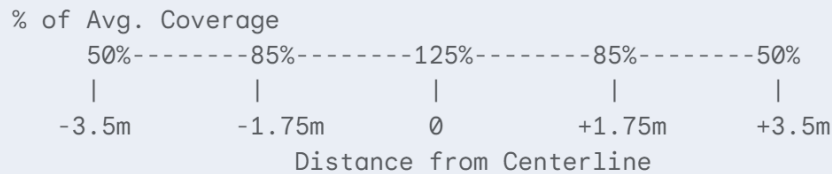


Chart 4.2.2: L30 at 4 Meters Height

- Effective Swath: 8.0 meters
- Pattern: Excellent uniformity, with a wide, flat deposition pattern.
- Best Use: The standard for broadacre crops like corn and soybeans.

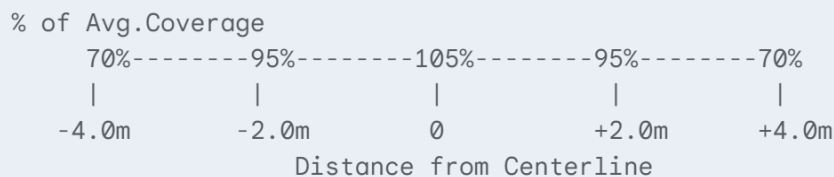
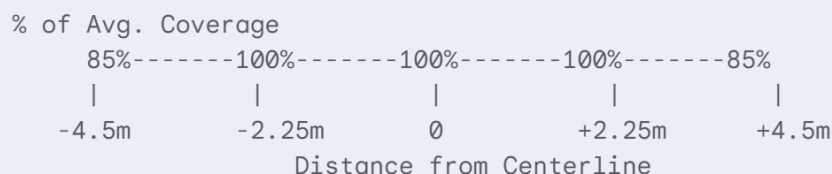


Chart 4.2.3: L30 at 5 Meters Height

- Effective Swath: 9.0 meters
- Pattern: Extremely wide and uniform, designed for maximum productivity.
- Best Use: Large-scale preventative treatments where efficiency is paramount.





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4.3 Adjusting Flight Speed for Spray Pattern Refinement

While the L10 and L30's intelligent system automatically adjusts the flow to maintain the target application rate (L/ha) regardless of speed, flight velocity still plays a crucial role in refining the spray pattern's shape and its interaction with the crop.

- **Faster Speed for Enhanced Uniformity:** As the drone moves faster, the surrounding airflow interacts more dynamically with the spray droplets. This can create a "feathering" effect at the edges of the spray swath, resulting in a softer, more gradual taper. This effect can lead to an even more seamless blend between overlapping passes, further enhancing field-level uniformity, especially when flying at higher altitudes for maximum efficiency.
- **Slower Speed for Canopy Penetration:** A slower speed allows the powerful downwash from the rotors to have a more direct and prolonged impact on the crop canopy below. This focused energy is ideal for driving droplets deep into dense canopies, ensuring the product reaches lower leaves and stems where pests and diseases may hide.

Operators can therefore use speed as a final tool for refinement: use a faster speed to achieve the highest level of uniformity on open field crops, and a slower speed when maximum canopy penetration is the primary goal.

4.4 Achieving Uniform Field Coverage with Overlap

The key to achieving true field-level uniformity is the precise overlapping of each spray pass. As the charts above show, the deposition rate naturally tapers off at the edges of a single swath. By setting the correct swath width in the flight planning software, the system ensures that the tapered edge of one pass is perfectly compensated by the tapered edge of the adjacent pass.

This technique smooths out the minor variations from each individual line, resulting in a highly consistent application across the entire field.



Chart 4.4.1: Uniform Field Coverage Through Overlapping Swaths

This chart illustrates how the tapered edges of two adjacent spray passes combine to create a consistent, uniform application. The goal is for the sum of the coverage in the overlap zone to equal the target rate (100%).

Example using a simplified single-pass profile:

```
Single Pass Profile -> | 50% ----- 100% ----- 50% |

Combined Field Coverage:
Pass 1 Application  ->          | 50% ----- 100% ----- 50% |
Pass 2 Application  ->                                | 50% ----- 100% ----- 50% |
-----
Resulting Total      ->          | 50% |    100%    | 100% |    100%    | 50% |
Field Coverage
```

- Result: The dip in coverage at the edge of Pass1 (down to 50%) is perfectly filled by the start of Pass2 (which provides the other 50%), resulting in a continuous, even application at the target rate (100%) across the entire field.

5.0 Conclusion

The effective and responsible application of agricultural products is dependent on the precise control of operational parameters. As demonstrated by our extensive internal testing and supported by the body of scientific research, flight height, flight speed, and droplet size are critical factors that must be optimized to ensure a uniform spray distribution.

The ABZInnovation L10 and L30 drones, equipped with advanced CDA systems, provide applicators with the necessary tools to control these parameters with a high degree of precision. The ability to select an optimal droplet size, combined with adherence to recommended flight speeds and heights, allows the L10 and L30 to achieve consistent, uniform coverage.



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This level of control supports modern precision agriculture by:

- Maximizing Efficacy: Uniform coverage ensures the proper dose is applied.
- Minimizing Environmental Impact: Precise control reduces off-target drift.
- Enhancing Safety: Applying product only where needed creates a safer environment.

We are confident that the ABZ Innovation L10 and L30 agricultural drones represent a safe, effective, and reliable platform for aerial application.

6.0 References

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