Spray efficiency: Are we missing the point?

By Marius Ras, managing director, RAS Consult (Pty) Ltd

Five million metric tons of chemical formulations are applied annually to protect crops from pests, diseases and weeds in a quest to optimise yield and crop quality to feed the world. Yet nobody knows whether the formulation reaches the intended target surface area at the levels of deposition to achieve the required outcomes!

Phrases such as "good coverage", "full cover", "adequate cover", or even the extreme "to the point of runoff" or "wetness" are used to conjure images of the required level of spray cover. In fact, these terms are used on the registration labels of the different formulations, although their meaning remains unclear.

This is where we completely miss the point. All of these descriptions refer to a certain amount of water that is used as reference and has nothing to do with the amount of formulation that gets deposited and settles on the target surface area.

Spray coverage explained

To understand the process of and variance in spray coverage, consider the following: The formulation is added to the water in the spray tank, according to the registered dose/100 litres. The mixture is then flow-calibrated, atomised and projected onto the crop target area.

Different droplet sizes react differently upon impact on natural surfaces (*Figure 1*). The very fine and fine droplets (*a*) have an 80% chance of depositing on first impact point. The medium droplets (*b*) have a tendency to bounce, with only 45% depositing on first impact. Course and very course droplets (*c*) burst and bounce, with only 15% depositing on the first impact point.

After final settlement, it stands to reason that only those droplets remaining on the target surface area will contribute towards the outcome required. These droplets are still a mixture of the formulation and water at approximately the same concentration as it was prepared in the tank mix. This can therefore be described as the coverage obtained.

Within seconds, the water will evaporate from this mixture, leaving only the formulation on the target area. This is described as deposition. The cycle has now been completed, where the formulation is now back to its original form – pure formulation – and is responsible for the outcomes intended.

Describing deposition efficiency

Deposition efficiency is determined by:

- Quantity (% fluorescent pigment deposition) of the formulation remaining on the target area.

Figure 1: Behaviour of different droplet sizes upon impact on natural surfaces.

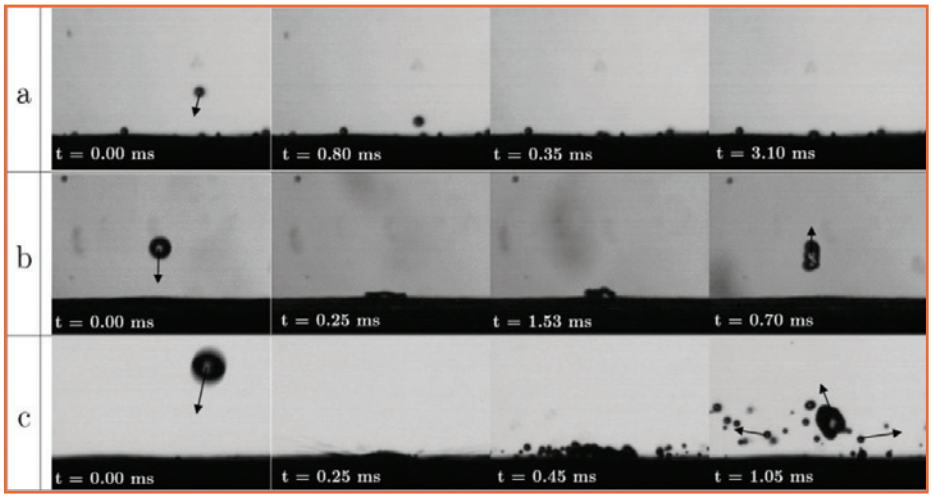


Figure 2: Water + formulation = coverage (1). Water evaporates = only formulation = deposition (2).

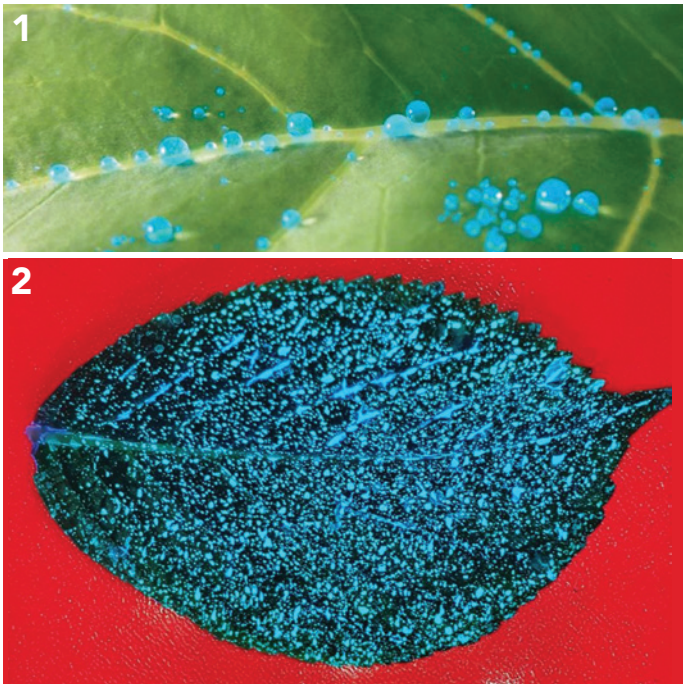
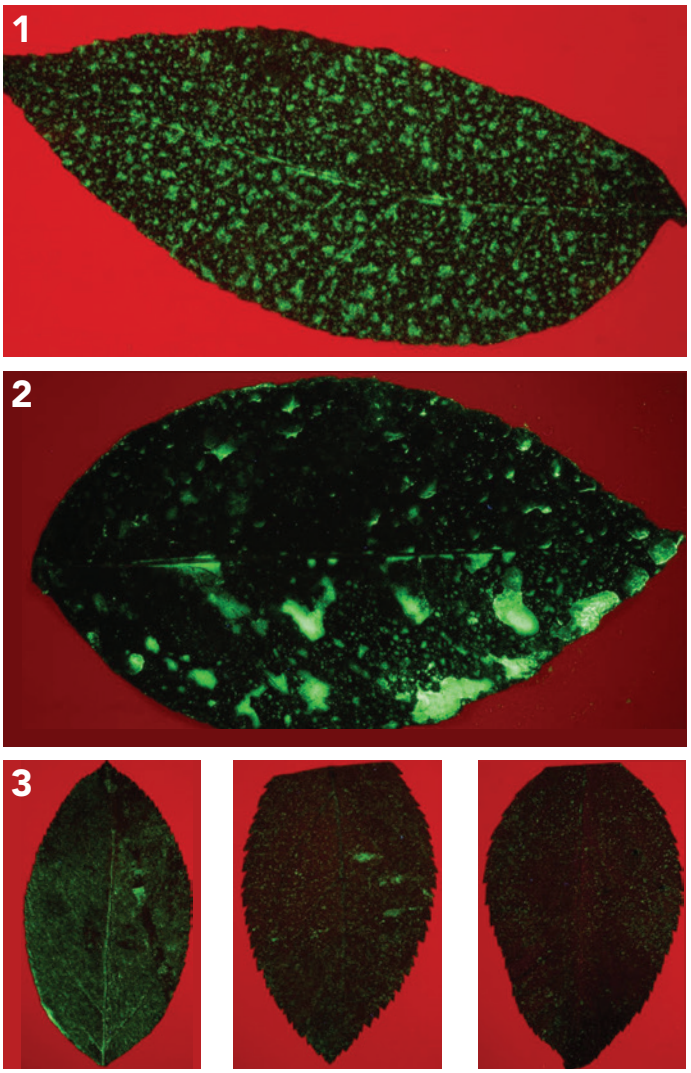


Figure 3: Quantity (1), quality (2) and uniformity (3) of deposition efficiency.



- Quality (% interquartile range of distribution) of the distribution of the formulation over the target surface area.
- Uniformity (% standard deviation) of the deposition of the formulation throughout the target crop canopy.

Measuring deposition efficiency

Visual references of surface 'wetness' or even comparing the blue stains on water-sensitive cards, provides no indication whatsoever of the actual deposition of the formulation. In fact, these are grossly misleading ways to evaluate the deposition efficiency of the formulation.

How then do you determine whether the money and effort spent on your spray application actually reach the intended target area to stand a good chance of protecting your valuable crop?

Measuring effectivity

Dropsight® technology (*www.dropsight.ag*) is a tool that measures deposition efficiency on natural surfaces on the farm. In a case study of deposition in potatoes at 370 ℓ/ha, the effectiveness of Dropsight® to determine deposition efficiency was demonstrated. Two variations were tested – upper-leaf deposition and under-leaf deposition.

Figure 4: A case study of deposition in potatoes at 370 ℓ/ha: Top of the plant, upper-leaf deposition.

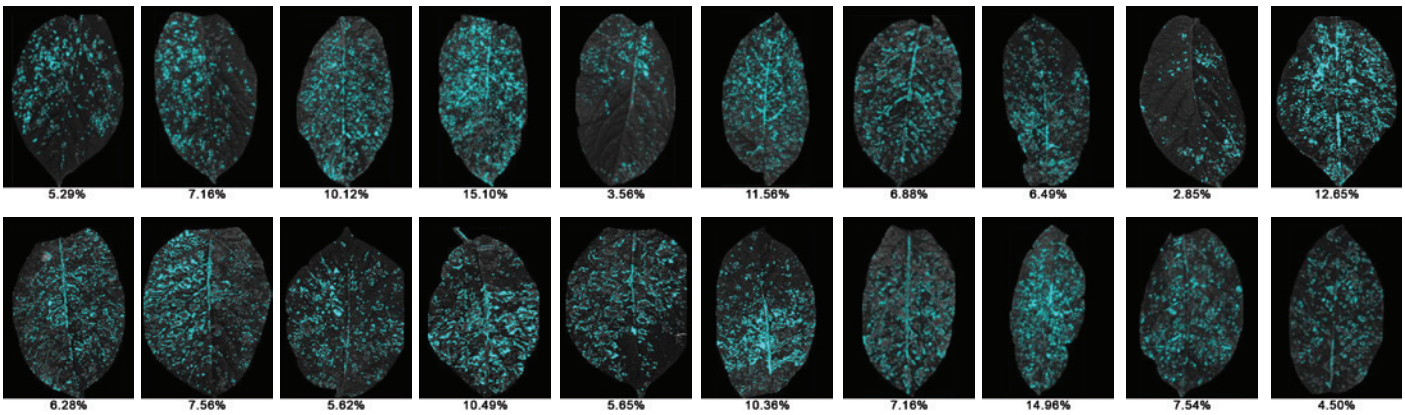


Figure 5: A case study of deposition in potatoes at 370 ℓ/ha: Top of the plant, under-leaf deposition.

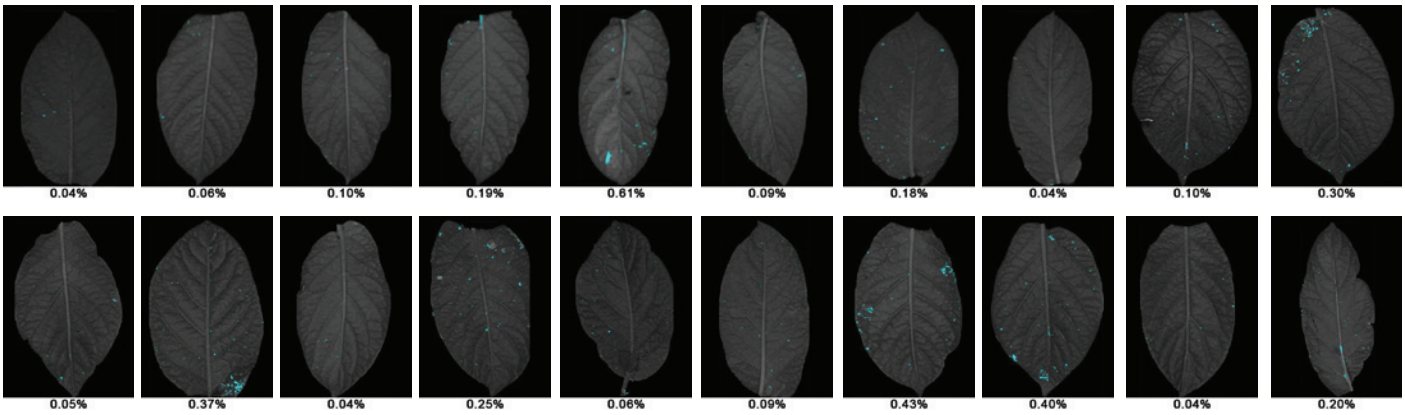


Table 1: Summary of results: Top of the plant, upper-leaf deposition.

Deposition quantity	FPC%
Minimum	2.85
Maximum	15.1
Average	8.09
Standard deviation	3.43
68% of values lies within	4.66 – 11.52
95% of values lies within	1.24 – 14.94
99.7% of values lies within	0 – 18.73

Table 2: Summary of results: Top of the plant, under-leaf deposition.

Deposition quantity	FPC%
Minimum	0.04
Maximum	0.61
Average	0.18
Standard deviation	0.16
68% of values lies within	0.02 – 0.34
95% of values lies within	0 – 0.5
99.7% of values lies within	0 – 0.66

The results are shown in *Table 1* and *2* and accompanying photographs.

It is very important for producers to know whether their spray application is actually reaching the intended target area, otherwise the effort will simply translate into money poorly spent and no protection for a valuable crop.

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VOL 36 NO 6 • NOVEMBER / DECEMBER 2022

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