Improving the application of biopesticides

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Optimising your plant protection applications

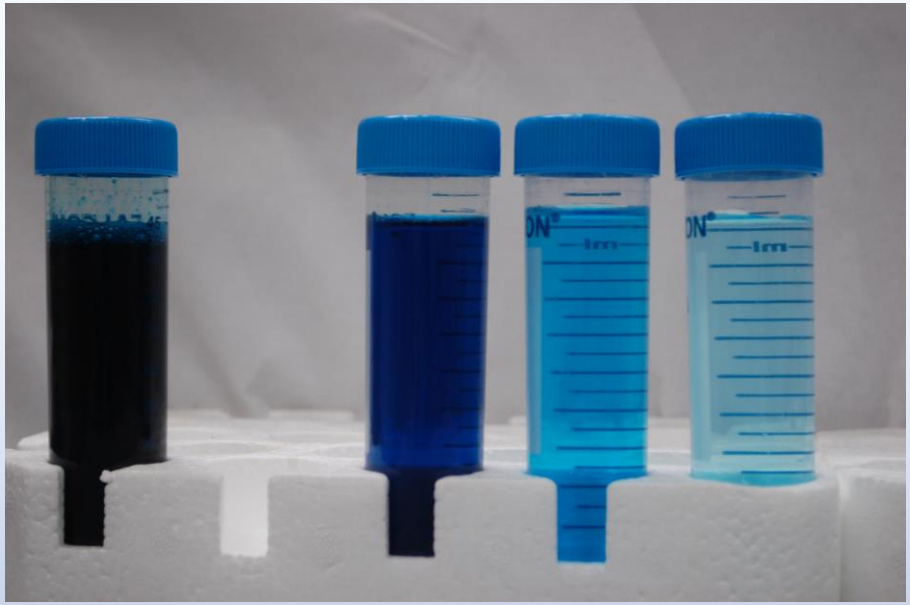
- Clean tanks
  - To optimise efficacy of biopesticide agent
- Good mixing of formulation
  - To ensure all active agent is released
- Application quality
  - Timely
  - Right quantity in right place
  - Sufficient to give control and minimise wastage

How clean is your tank?

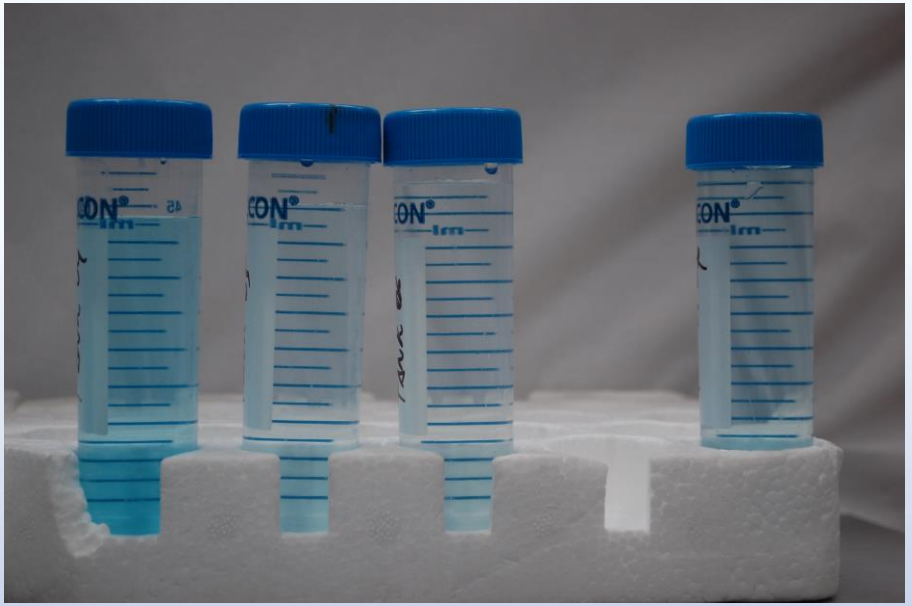
- Biopesticides contain living organisms
- Contact with PPP residues from previous applications can harm these organisms and reduce efficacy.

Understanding how clean a spray tank is after triple rinsing

Residues are difficult to eliminate



Effect of triple rinsing
(10 minute recirculation for each rinse)



Left for 30 mins with a further 10L clear water. Then additional rinses with 10 minute recirculation

Dedicated biopesticide tank and spray system?

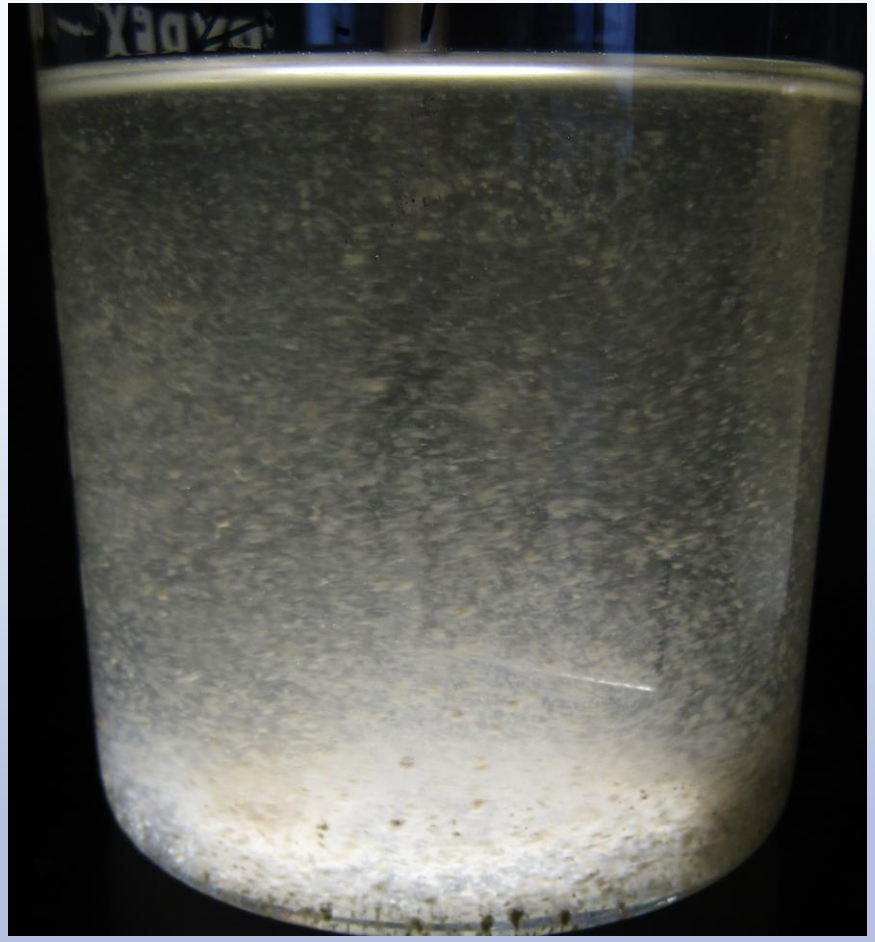
Mixing:
Importance of following the label when mixing biopesticides

- Lumpy deposits – are potentially un-released spores which can lead to:
  - Reduced application of active material
  - Reduced efficacy
  - Blocked nozzles affecting uniformity of application

- The challenge is to ensure a uniform mixture is sprayed throughout application
  - Ensure thorough initial mixing of the product
  - Maintain mixing in the tank during application

- Does the type of water affect how well the product mixes?

Hard tap water vs deionised (soft) water



Potential for lower dose application and nozzle blocking

What are the important application factors?

- Accurate dosing
  - Calibration, uniformity
  - Precision, targeting
- Water volume
  - Accurate dosing
  - Speed of operation
  - Operator/environmental contamination
  - Mode of action
- Distribution of product
  - Understanding where it needs to be
  - Underside of leaves?
  - Good ‘coverage’???
- Size of deposit
  - Initial droplet size
  - Spreading characteristics

Investigation into Optimising volume for a bushy ornamental plant - chrysanthemum

- Generic investigation of this type of protected crop to demonstrate the principles
- What volume of spray liquid delivered by the sprayer results in the maximum volume of spray liquid on the plant?
- What volume of spray liquid results in the maximum dose to the plant?

Experimental design

- Spray delivered by a 3-nozzle boom on a track sprayer, fine spray
- Six pots per treatment (4 plants per pot)
- Change volume by changing speed only – droplet size remains the same
- Six volumes: 100 – 1000 L/ha
- Water + dye + 0.1% wetter
- All plant material sampled
- Separated into upper and lower levels in the pot
- Collecting discs put on soil
- Seventh pot also sprayed and 10 leaves sampled for quantifying deposit on upper leaf surface and underside of leaf.

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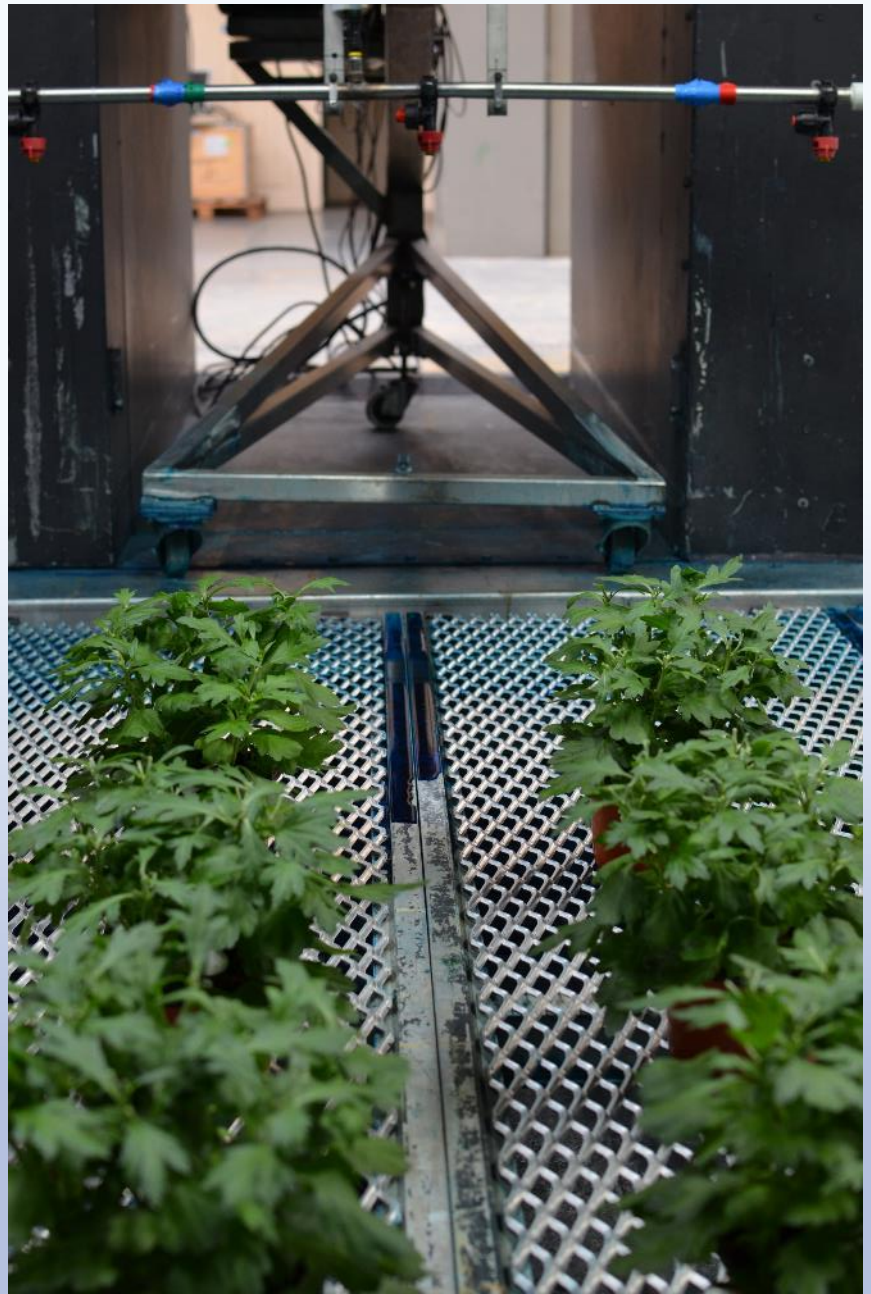
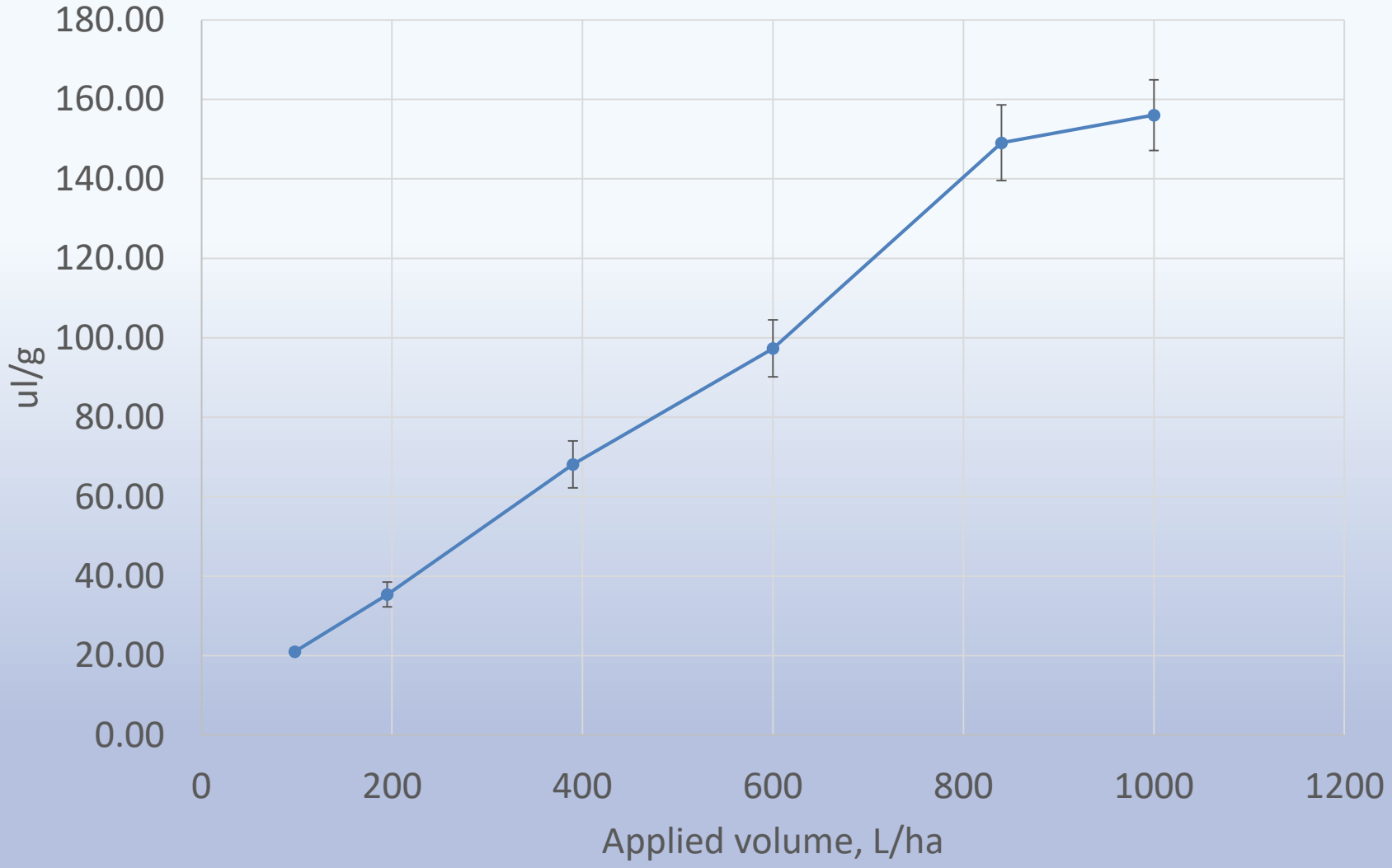
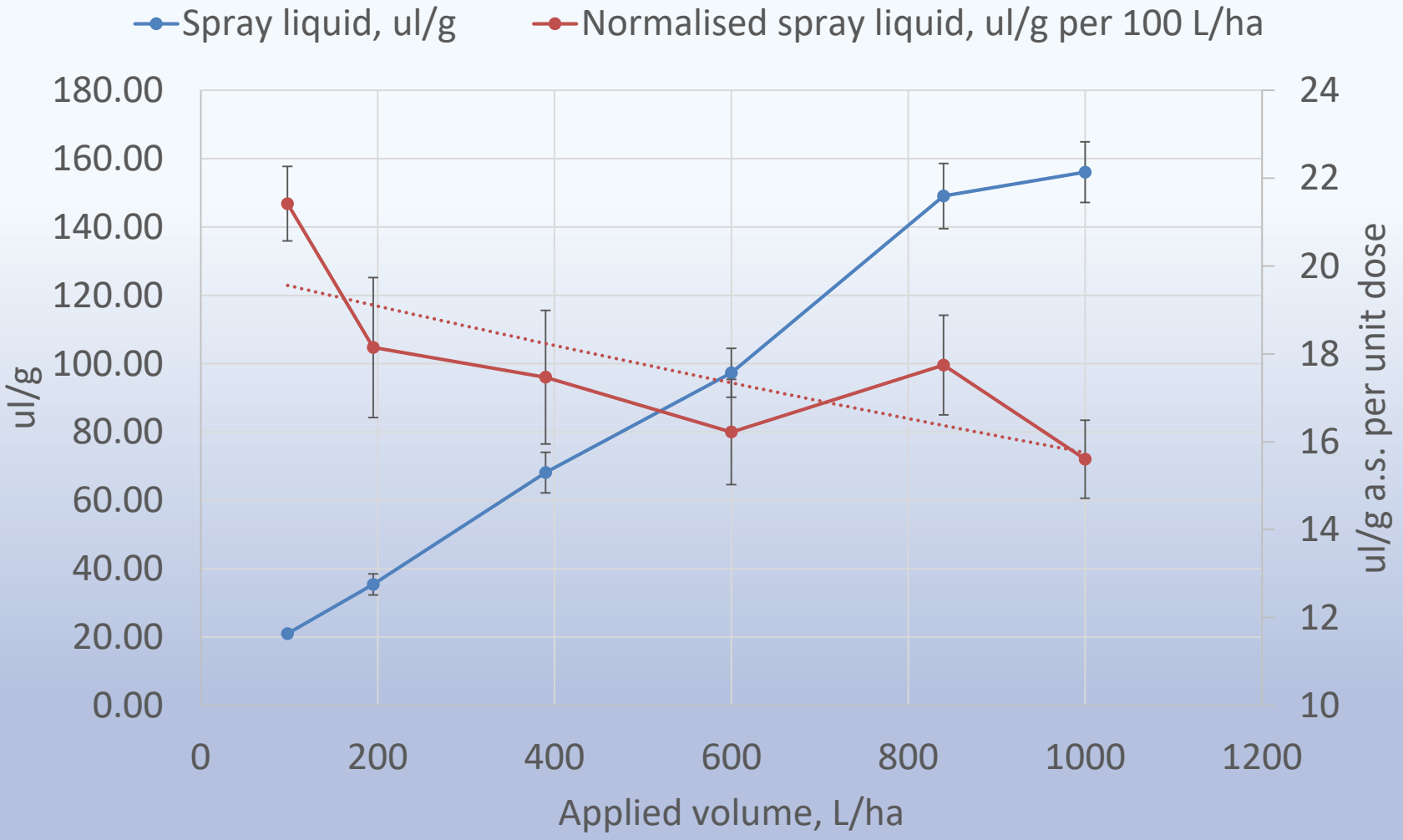


Spray liquid deposit on whole plant



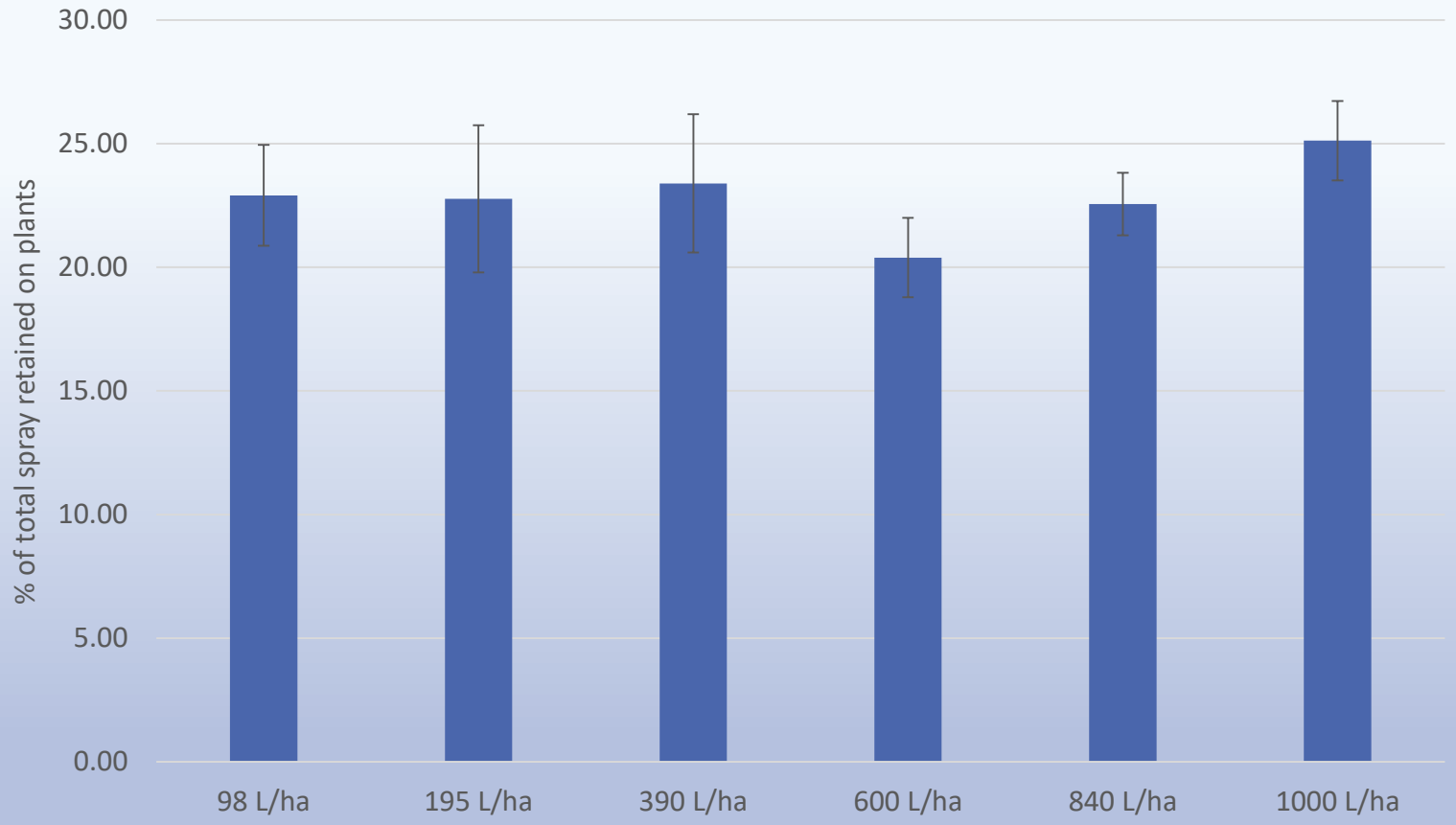
Normalised (active substance) deposit on whole plant



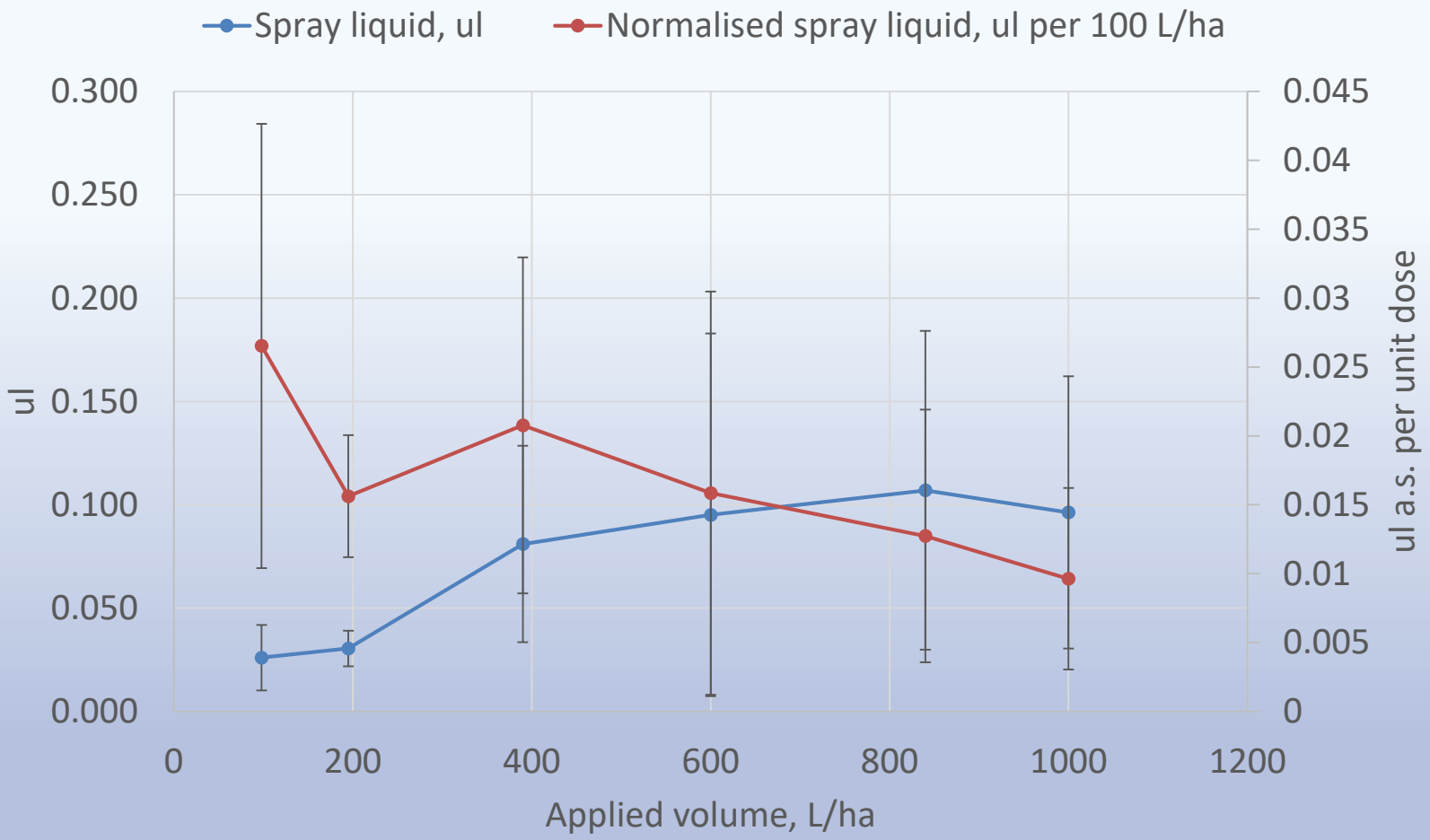
Key points - to achieve optimised deposits on plants

- Pot mums can hold a large amount of liquid (~ 1000 L/ha)
- Most efficient volume is still the least you can get away with (< 100 L/ha)
- 100 L/ha put on 37% more active substance than 1000 L/ha *for a constant applied dose*

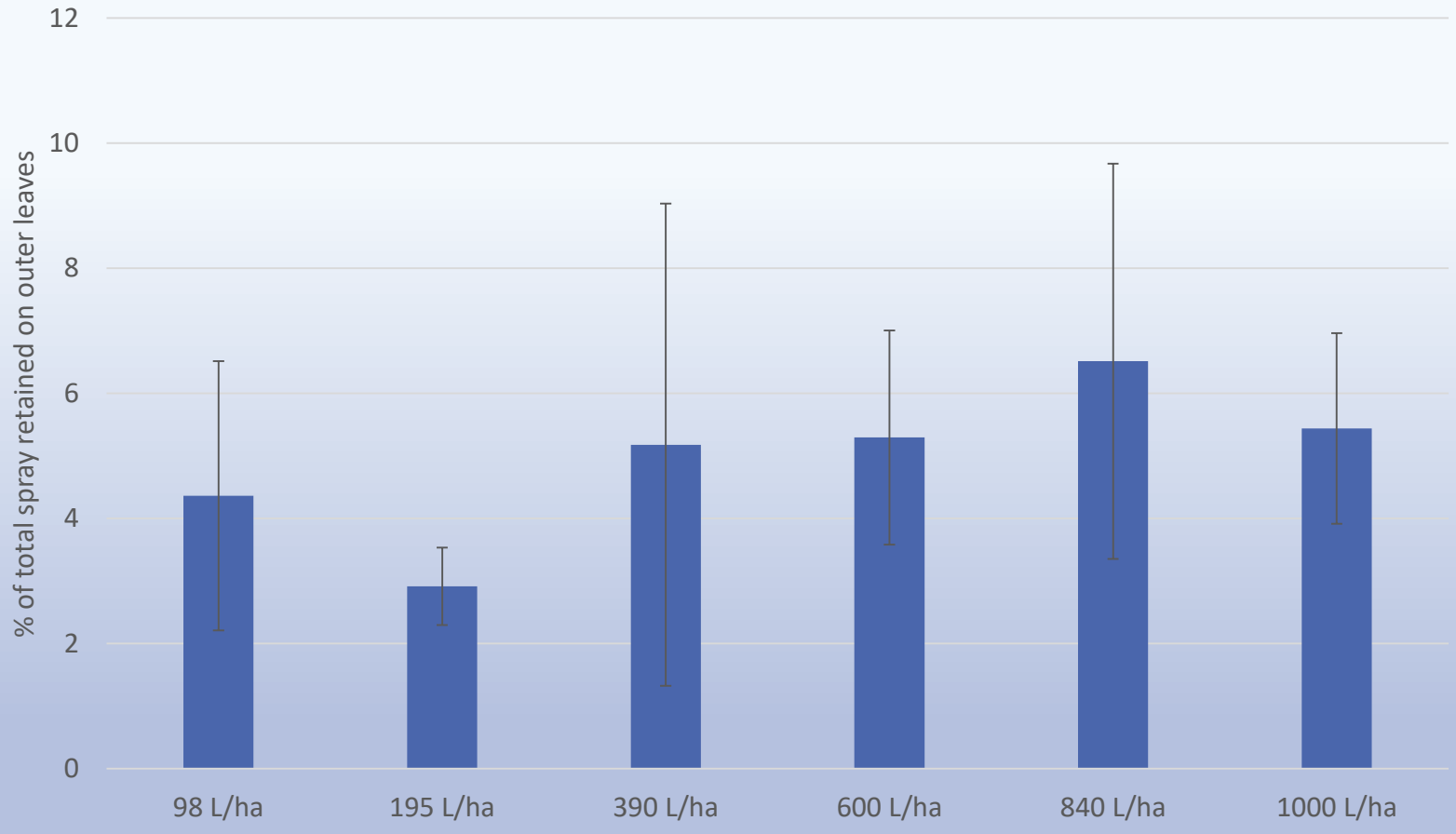
Penetration into plant canopy – deposit on lower half of plant



Spray reaching soil

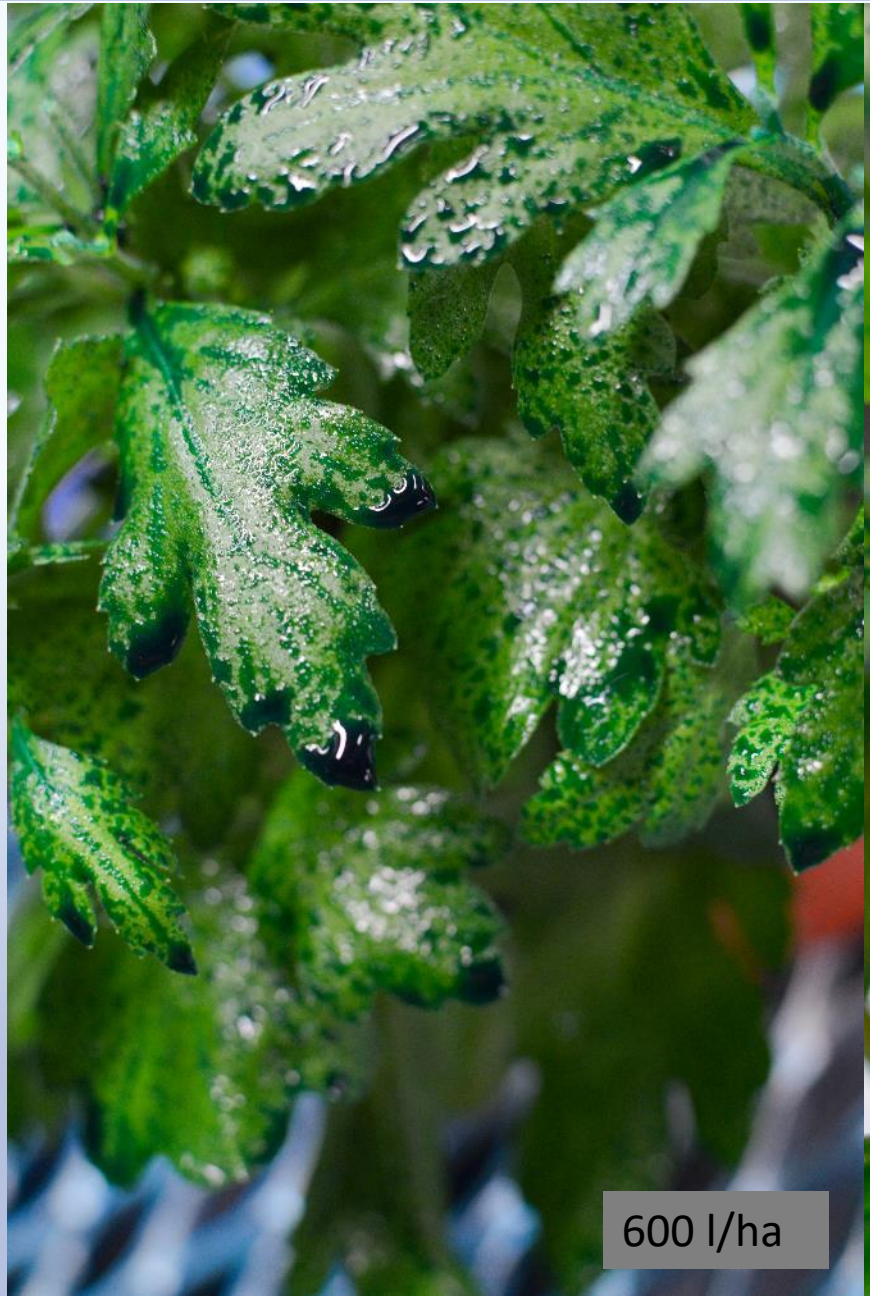


Proportion on underside of leaves




195 l/ha


390 l/ha


600 l/ha


1000 l/ha

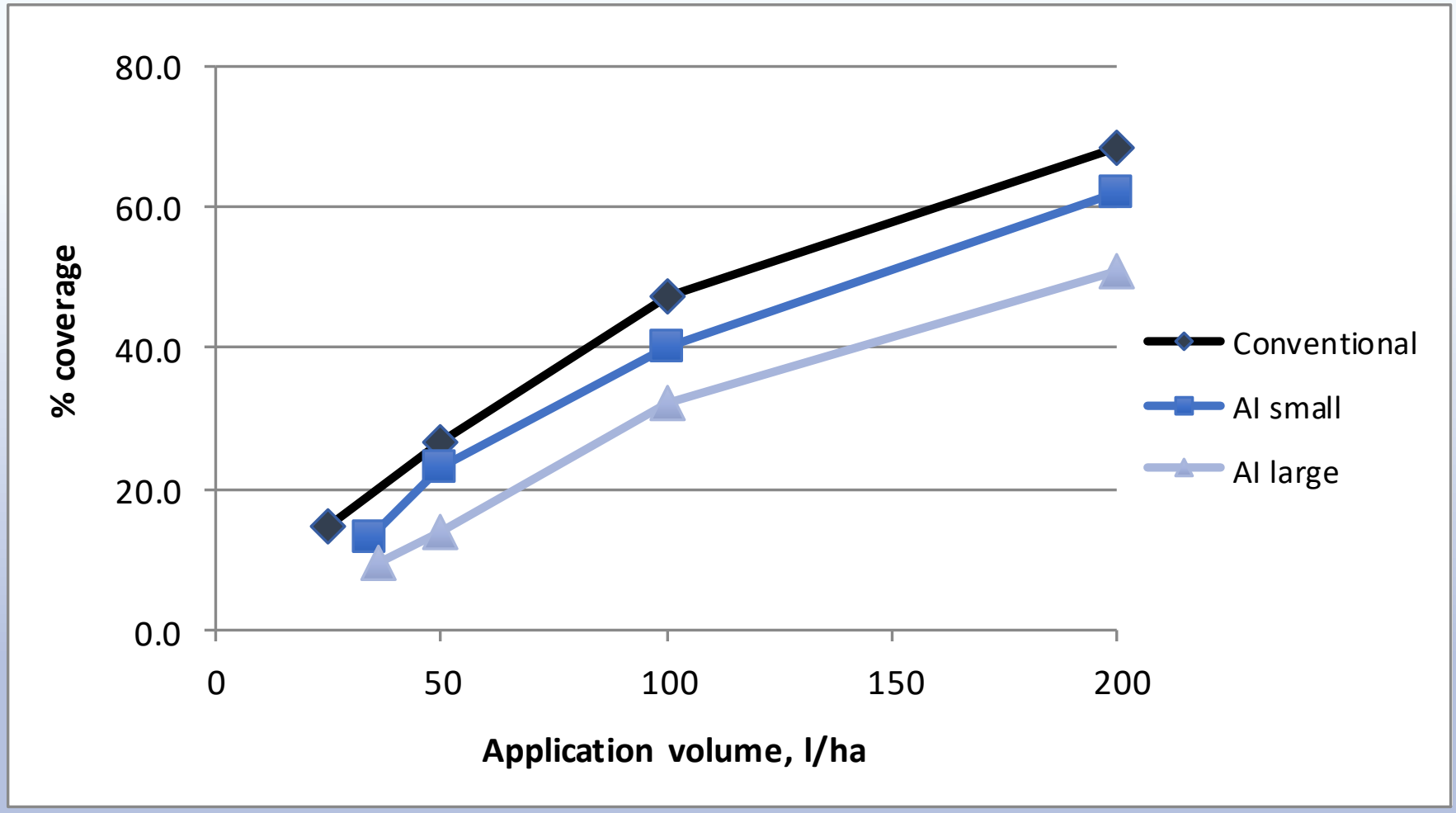
How volume affects dose

- For a given dose, water volumes greater than 100 L/ha reduces the quantity of **active substance** on the plant,
- Water volumes greater than 100 L/ha do not improve the distribution of spray over the plant
- Lower volumes and higher concentrations can give significant benefits – higher doses *on the plant* and better work rates
- Higher water volumes *may* be required
  - To slow down drying
  - For operator exposure reasons
  - To improve the area of a leaf covered by spray liquid

Biopesticides

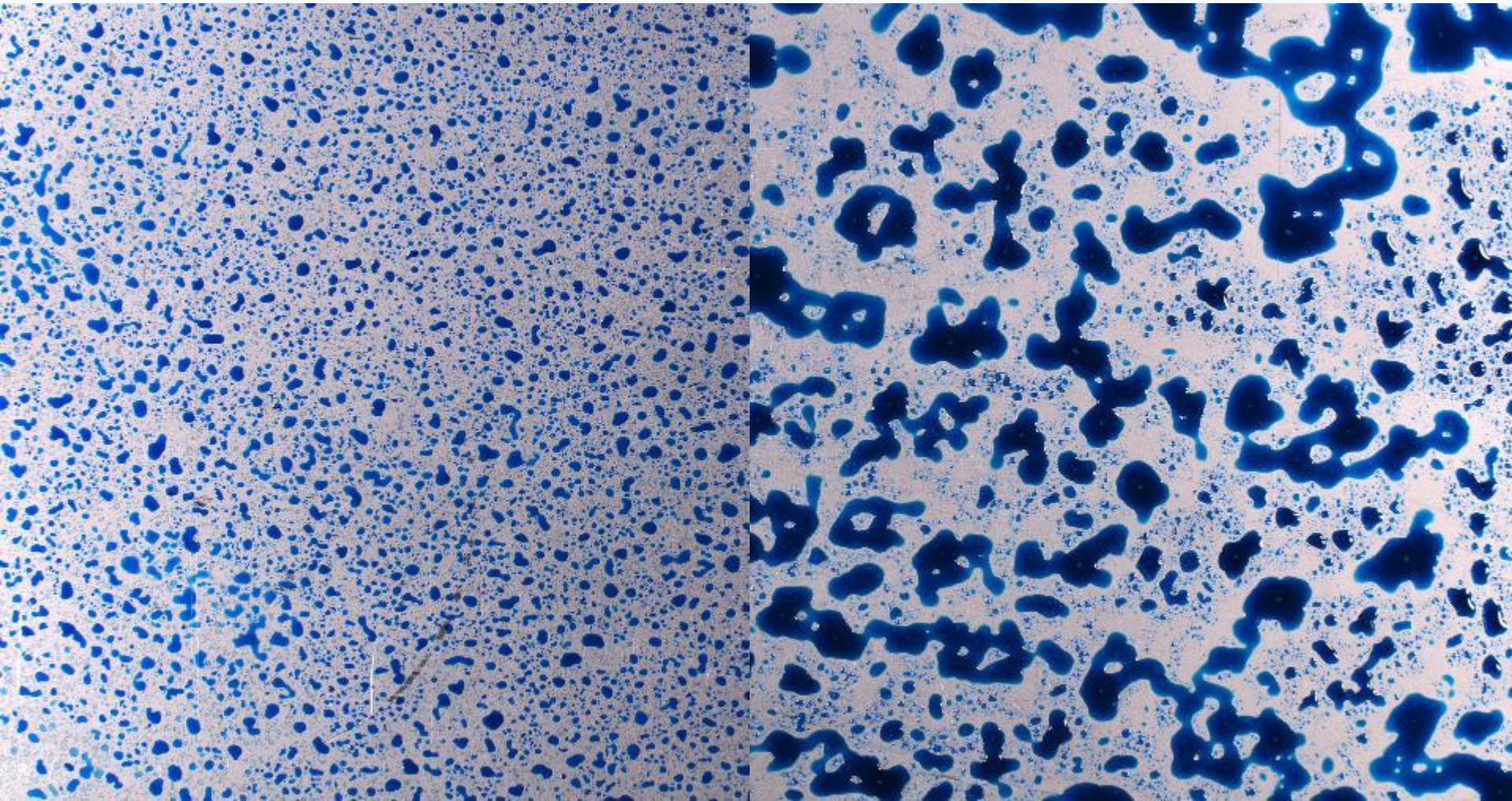
- Generally need to make contact with the ‘pest’
  - Need to know where ‘pest’ will be
  - Need to know the optimum distribution of a.s.
- Some surface moisture might be needed to ensure spores survive
  - How much and for how long?

Effect of application (nozzle type) on % area of paper visibly covered by water

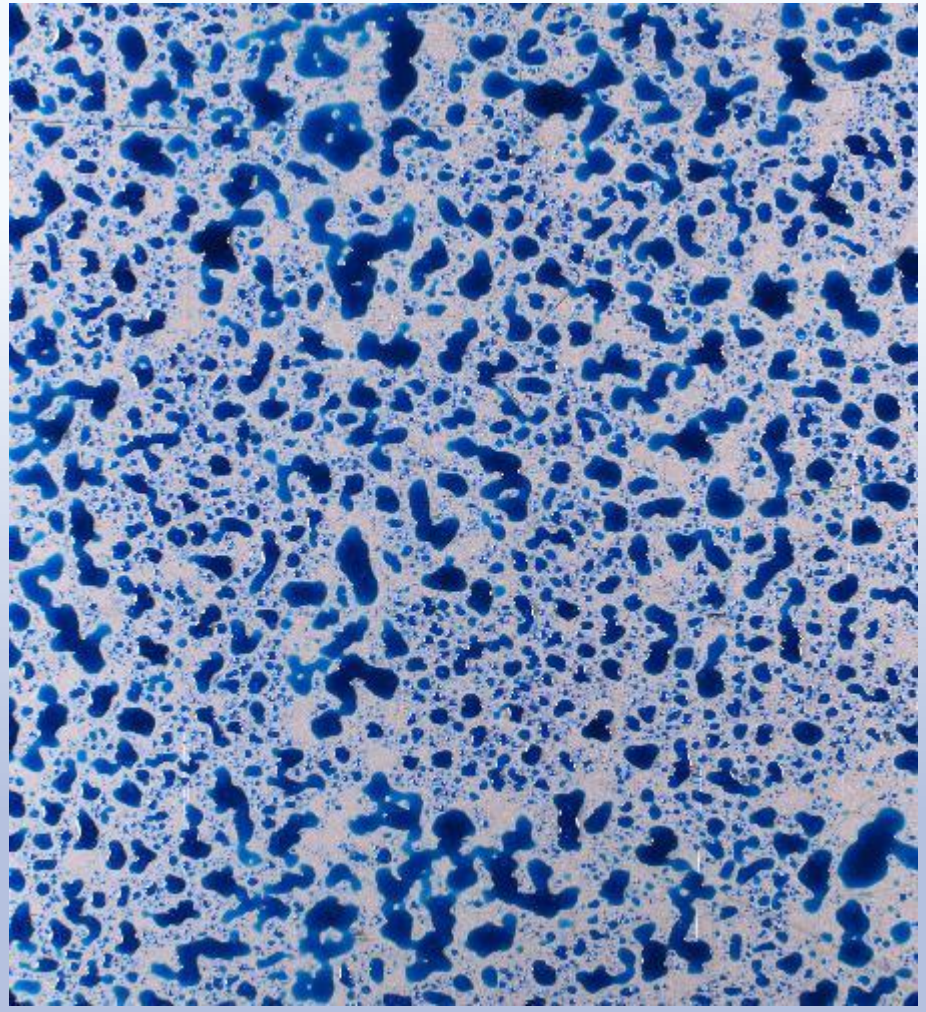


Deposit on steel plates

240 L/ha & 960 L/ha



Maximum area covered for steel – 600 L/ha



- Perfectly flat, uniform target
- Any additives (spreaders, wetters, co-formulants) will reduce the volume for maximum area covered
- The waxier the leaf, the less liquid will be retained, particularly if not horizontal

What is the optimum volume?

- Almost certainly less than the volume that gives the maximum amount of spray you can deposit on the plant

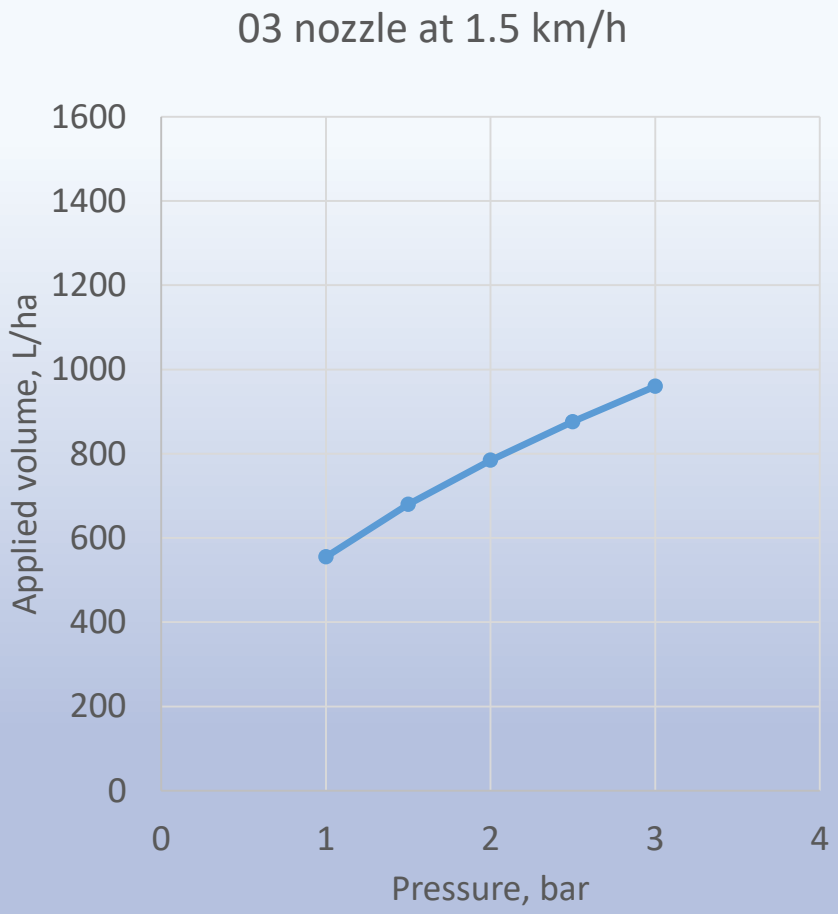
- Need to identify the volume that delivers the maximum amount of active substance to the plant with the optimum deposit characteristics

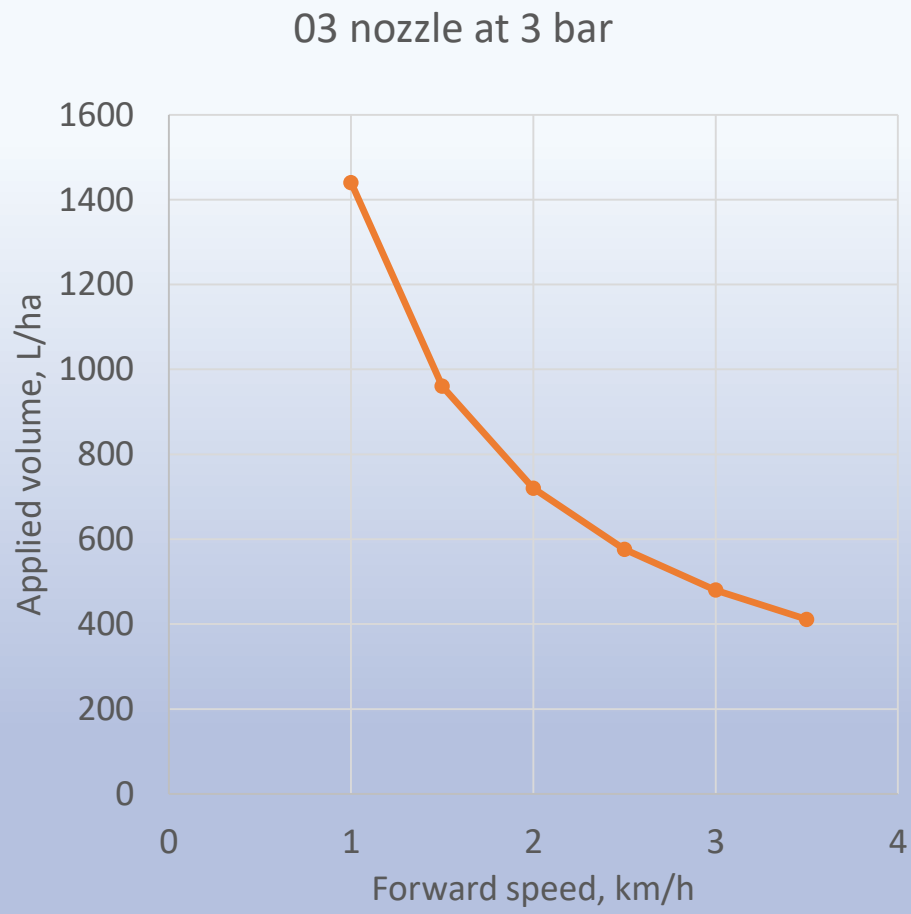
- No volume will cover 100% of the leaf surface without something to reduce surface tension
    - Biopesticides appear to have little in the way of spreaders or wetters added

- Optimum volume highly dependent on:
    - Plant structure
    - Leaf surface and the interaction with product formulation
    - Mode of action of biopesticide
    - Spray application parameters

How can we achieve lower volumes?

Increasing speed is a more effective way to reduce volume than reducing pressure





Existing guidance on application volumes

- Labels are aimed at *regulators*, not users
- Users often struggle to interpret labels and implement instructions in practice
- 'Just before runoff' is not an appropriate volume instruction
  - Can't judge it by eye – always overestimated
  - Not the most efficient volume
- The most 'efficient' volume is likely to be significantly lower than runoff
- BUT – we need to engage with the manufacturers to make sure reducing volumes can be supported
- Once volumes are reduced, it is likely that application technique (nozzle, droplet size etc) becomes more important

Key messages

- Be accurate
  - Calibrate
  - Maintain and clean equipment
  - Thoroughly mix formulation
- Strive for uniformity
  - Boom systems better than hand-held lances
- Reduce volumes where possible
  - move quicker!
- Understand the pest
- Take account of crop structure
- There are no easy alternatives to current ‘low-tech’ systems in protected crops
- Innovative engineering solutions are possible – but development needs to be funded