How can we help growers get the most out of bio-fungicides? The AHDB AMBER project.

Dave Chandler[1], Elysia Bartel[2], Jude Bennison[2],Clare Butler Ellis[3], Roma Gwynn[4], Rob Jacobson[5], Andrew Lane[3], Aoife O'Driscoll[2], Christine O'Sullivan[3], Gill Prince[1], Sacha White[2], Erika Wedgwood[2]

[1]University of Warwick UK; [2]RSK ADAS UK; [3]Silsoe Spray Applications Unit, Silsoe UK; [4]Rationale Biopesticides, UK; [5]Rob Jacobson Consultancy Ltd, Bramham UK.

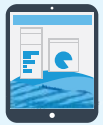
contents

- Background context to the AMBER project.
- Project aims.
- Work areas.
- 2 areas relevant to biofungicides: spray application & timing.
- What messages are we giving to growers?

Bio-based crop protection – identified as transformative for global agriculture (World Economic Forum 2018).

Creating effective production systems

PRECISION AGRICULTURE FOR INPUT AND WATER USE OPTIMIZATION



- Reduce farmers' costs by up to $100 billion
- Increase production by up to 300 million tonnes
- Reduce freshwater withdrawals by up to 180 billion cubic metres

BIOLOGICAL-BASED CROP PROTECTION AND MICRONUTRIENTS FOR SOIL MANAGEMENT

- Increase production by up to 50 million tonnes
- Reduce GhG emissions by up to 5 megatonnes of CO_2 eq.

GENE-EDITING FOR MULTI-TRAIT SEED IMPROVEMENTS

- Generate up to $100 billion in additional farmer income
- Increase production by up to 400 million tonnes
- Reduce the number of micronutrient deficient by up to $100 million

OFF-GRID RENEWABLE ENERGY GENERATION AND STORAGE FOR ACCESS TO ELECTRICITY

- Generate up to $100 billion in additional farmer income
- Increase production by up to 530 million tonnes
- Reduce freshwater withdrawals by up to 250 billion cubic metres

MICROBIOME TECHNOLOGIES TO ENHANCE CROP RESILIENCE

- Generate up to $100 billion in additional farmer income
- Increase production by up to 250 million tonnes
- Reduce GhG emissions by up to 30 megatonnes of CO_2 eq.

Biologics / biopesticides in horticulture: UK grower experience

Increasing products on market

Growers want to use them

Test them out

Some products useful

Others poor / inconsistent

Reasons unknown

Lack of knowledge on how best to use

The AMBER project: an overview

- **A**pplication & **M**anagement of **B**iopesticides for **E**fficacy & **R**eliability.
- PE, PO & HNS crops. Microbial biopesticides.
- Identify the reasons why biopesticides can be inconsistent.
- Develop generic management tools and practices to improve performance (all crops, all pests / diseases!) –
  - a very broad project.

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Biopesticides in commercial practice: benchmarking trials

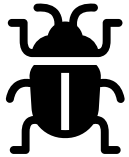
Observed growers using microbials on crop scale.

- Natural P&D outbreaks.
- Followed best practice guidelines.
- Compared to standard treatment if possible.

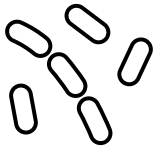
5 fungal BCA products

6 commercial growers

7 crops (pepper, cucumber, 5 ornamentals)



3 pests (aphids, thrips, whitefly)



3 diseases (mildew, botrytis, root rots)

Detailed quantitative & qualitative information on biopesticide / grower performance

Product storage; sprayer performance, pressure, water volume, concentration; deposition on the crop; effect of spray on product viability; persistence; amount of P/D control; environmental conditions; non-target effects; phytotoxicity.

Observations of biofungicide performance in Amber

Cucumber: *Ampelomyces* vs powdery mildew;
Vertical boom, manually operated.

- Acceptable disease suppression on variety with intermediate resistance only.
- Concerns about tank residue effects on biofungicides?
- High volume application. Uneven distribution on crop.

Cyclamen: *Gliocladium* vs *Botrytis*; Ripa gun; Brinkman 200l tank sprayer

- 2 applications, 3 wk intervals, 6 wk crop. Standard: alternating Rovral & Amistar.
- *Gliocladium* gave more control than fungicide standard. Control could be better in both cases.
- Week 1 (plants with *Botrytis*): Standard = 60%; *Gliocladium* = 28%.
- 2 weeks after 3rd spray: Standard = 84%; *Gliocladium* = 56%.
- Estimated vol. 3000 l per ha.

Dianthus & Choisya: *Trichoderma* vs root rots; Drench with a hand lance.

- No difference in *Trichoderma* and fungicide standard.
- High volume application (10% pot volume).
- Better root growth with Previcur Energy.

Overall, across all biopesticides, what did we learn?

- Performance varied, from zero control, to better than conventional pesticides.
- All products had potential to give much better control.
- Application was poor (with 1 exception). Targeted, precision application needed, but the tools / knowledge are not yet available or in use (deliver effective dose, right time, right place).

What else did we find?

- Labels hard to follow.
- Lack of accessible ‘underpinning’ information (effective dose, persistence, environmental conditions etc.). *Companies addressing this now.*
- Growers need better knowledge (mode of action, storage, preparation, compatibility etc.).
- Spray equipment not fit for purpose (1 exception).
- Water volumes too high (run-off, inefficient).

AMBER: work areas

- Making **spray application** more efficient.
- Measuring biofungicide **persistence** to improve timing of application.
- A Boxcar **model of insect pest growth to** inform bioinsecticide use strategy.
- **Thermal time model** to predict bioinsecticide efficacy at fluctuating temperatures.
- Improved **data recording template** for biopesticide trials.
- Forward look – how decision support & precision application will impact on biopesticide management.

Knowledge exchange

- Grower articles.
- Talks and workshops for 9 crop sectors.
- Application workshops (> 100 growers / agronomists).
- Website, YouTube

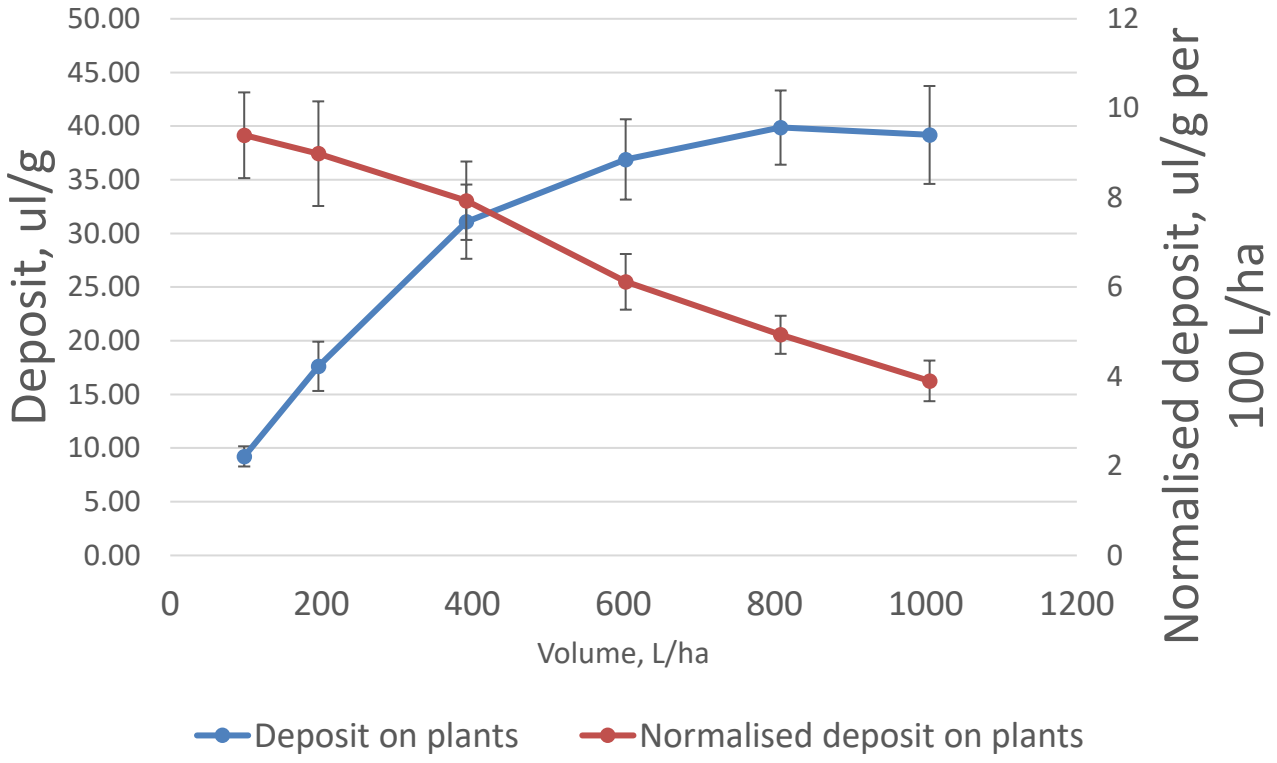
Biopesticide spray application workshops

- Correct storage, mixing, tank washing.
- Principles of good spray application (water volumes).
- Peer to peer discussions led by grower ‘pioneers’.

Spray application is a critical factor

- Biopesticides are not ‘forgiving’. If spray application is poor, they are likely to fail.
- Water volumes are usually too high: inefficient to apply, with loss of product through run off.
- For best results, control the water volume to achieve the highest concentration of biofungicide on the leaf surface.
- Many people still believe high water volume is best. The truth is more complex.

Silsoe Spray Applications Unit: spray water volumes (tracer dye, track sprayer, constant dose) – short crop



- Dye is more dilute at higher volumes.
- Deposit = mean amount per g leaf tissue.
- V low volumes, not all leaves are sprayed.
- Higher volumes, leaves are saturated & run off occurs.

Tracer dye studies: On short crops, horizontal boom

- Amount of active substance deposited on the plant is sensitive to volume.

- Product applied at a constant dose: maximum active substance = lowest water volume (but do not exceed max label concentration).

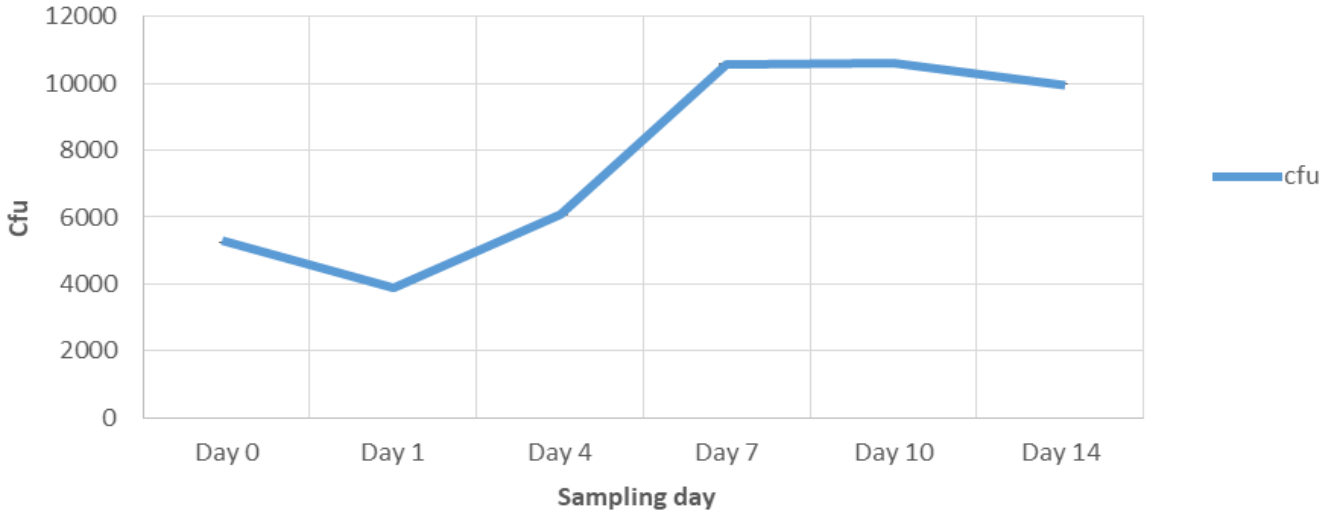
- Product applied at a constant concentration: the max volume = 1000 L/ha, but for smaller plants it is better to go 500 L/ha.

Tracer dye: On tall crops, vertical boom

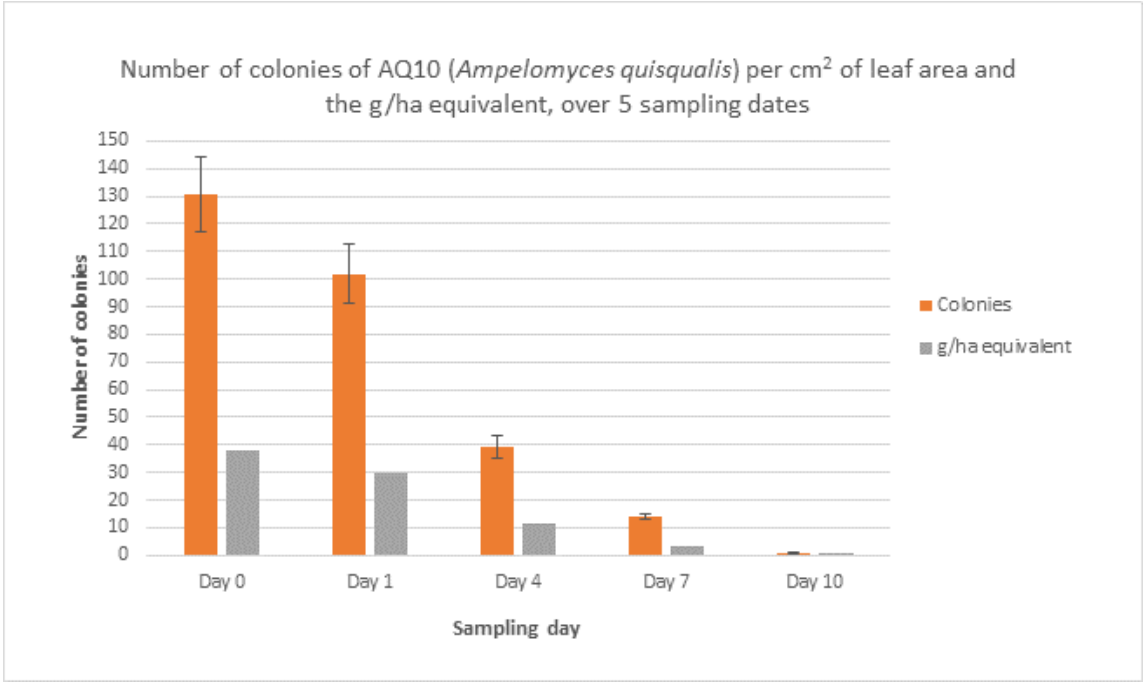
- Amount of active substance deposited on the plant is relatively insensitive to volume.
- Product applied at a constant dose: choose low water volume to make application time efficient.
- Product applied at a constant concentration: the max volume = 1000 - 1500 L/ha.
- Silsoe calculator: converts volume needed for vertical crop into volume applied per floor area. Ensures label recommendations aren’t exceeded.

Biofungicide persistence determines application strategy

- CFUs of *G. catenulatum* on foliage of tomato plants.
- Sampled for up to 14 days after application of Prestop WP to leaves with no host disease present.



Poor survival of *Ampelomyces* in absence of host



Some grower users thought *Ampelomyces* was a true preventative

- Used to inform a smart decision support system

Narrow use window

Integration with conventional fungicides

- Not stand-alone products. Use them to reduce conventional fungicide applications.
- Knowledge gaps about fungicide compatibility.
  - Safer to have separate tanks.
- But there are reports from scientific literature of co-application with compatible fungicides, giving superior control:
  - Trichoderma.
  - Bacillus and azoxystrobin
  - These are experiments. We need to check them out.
- Use biofungicide in a programme to reduce the number of conventional fungicide applications.

Biopesticides have a critical role in future crop protection – but we must use them better

- Assess performance under real world conditions. Why do they work / not work?
- We still think of them as like-for-like replacements of conventional pesticides.
- Precision spray application. New equipment. Deliver effective dose, right place, right time.
- Smart decision support (predictive modelling, IoT sensors, cloud computing, dashboards).
- Identify synergies within IPM (e.g. with durable plant resistance, plant vaccination, natural enemies).

Advice for growers & agronomists

- Use biofungicides in a programme to reduce total number of conventional fungicide applications.
- Measurable, incremental improvements in management practice rather than a ‘giant leap’.
- Combine with other IDM tools (cultural control, environment management). Smart decision support.
- Biofungicides work differently to conventional fungicides. They are less forgiving and require much more attention to detail.
- Take into account the modes of action. Consider compatibility with other products.
- Good spray application is critical. Efficacy is dose dependent; deliver highest dose of product per unit area of foliage. Lower water volume is best. Label reform needed.

Don’t forget why we are doing this…

- Helping growers achieve sustainable production of quality food & ornamentals.

AMBER

Thankyou

Google ‘amber biopesticides’

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