Helping growers get the best out of biopesticides for more sustainable crop protection

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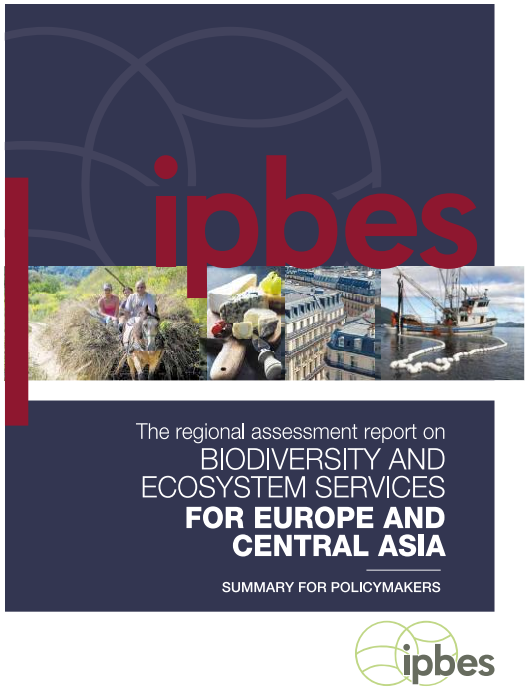
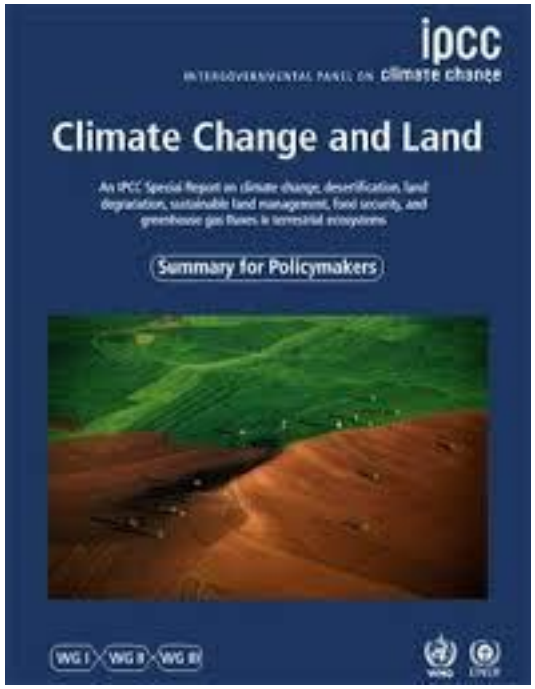
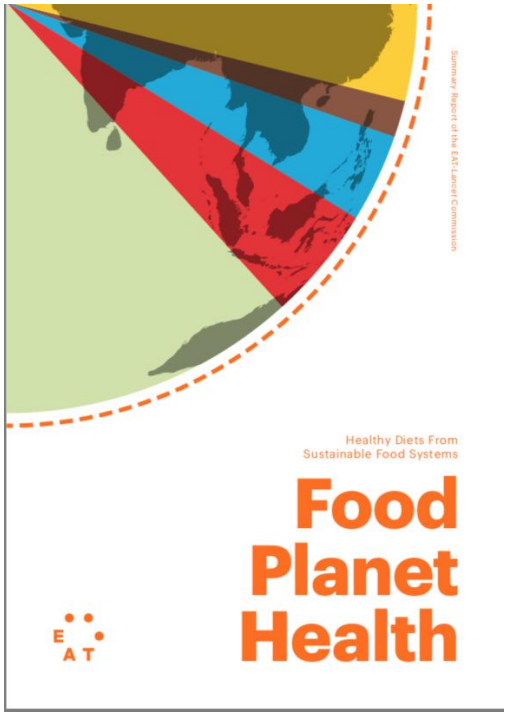
A new, sustainable agricultural revolution is coming….







Crop protection – a constant challenge

The 1960s Green Revolution:
Unsustainable use of conventional chemical pesticides

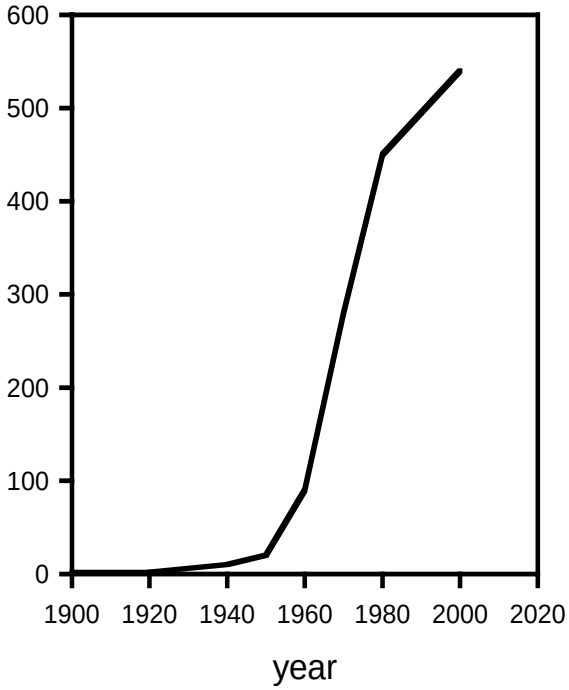
- **Evolution of resistance**
- **Environmental damage**
- **Health concerns**

Reduction in availability:

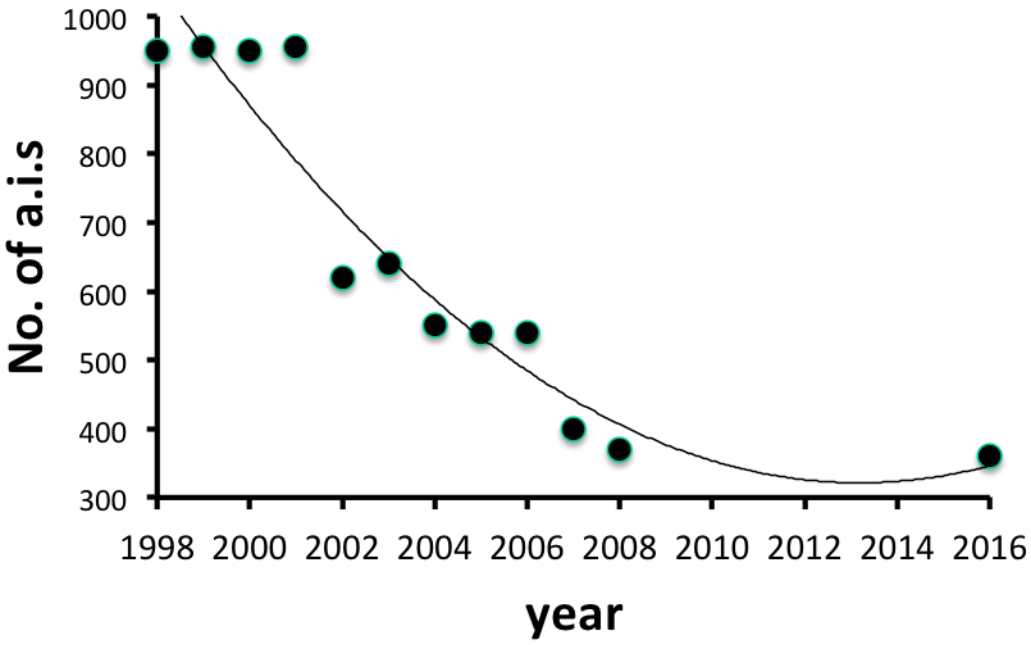
- **Products stop working.**
- **Government restrictions.**
- **Retailer restrictions.**
- **Pesticides – precious resource.**

Pest: invertebrates, plant pathogens, weeds

Declining availability of synthetic chemical pesticides



Insecticide resistance (world)



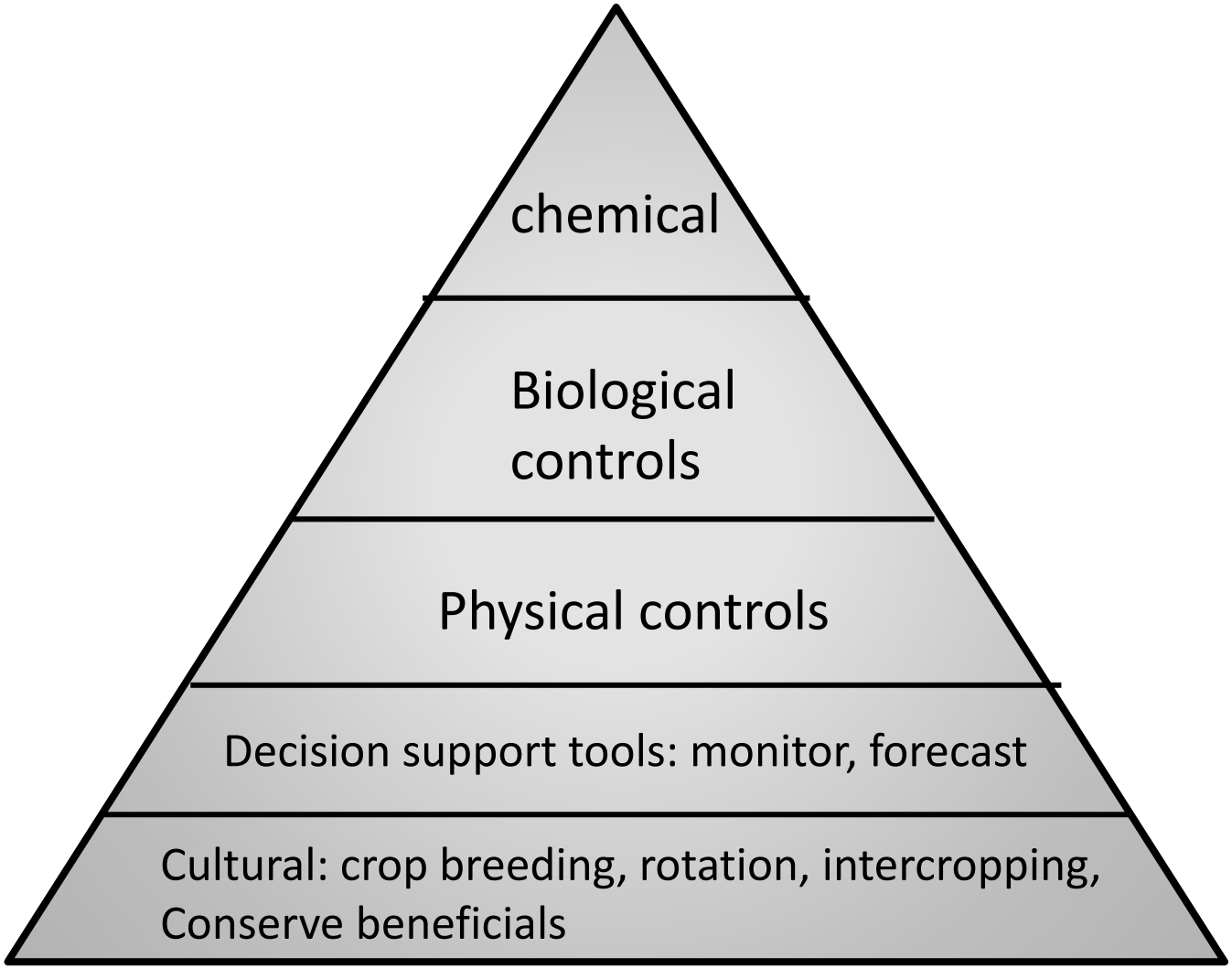
Conventional pesticides approved in EU

- More stringent regulations now in place (EC 1107/2009).
- Few new pesticide a.i.'s being developed.

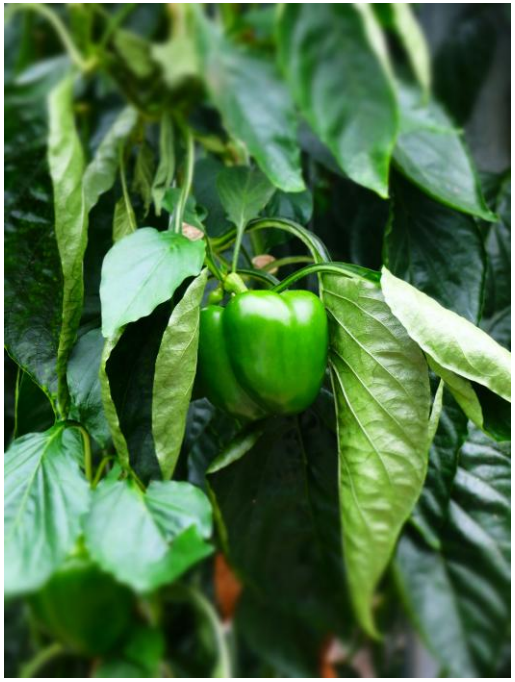
IPM is the way forward

- Systems approach: combines different crop protection practices with monitoring of pests and natural enemies, and decision support.
- Manage pests below economic damage threshold.
- Proven to be beneficial.
- Mandatory under **EU Sustainable Use Directive** on pesticides:
  - "biological, physical and other non-chemical controls must be preferred to chemical methods if they provide satisfactory pest control."

Sustainable crop protection: the IPM pyramid



IPM: Adoption / sophistication / practices vary across sectors



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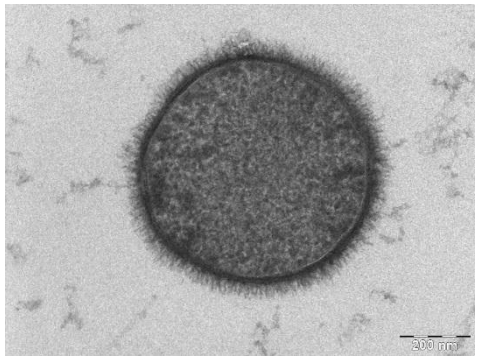
Address barriers to uptake & adoption

Biopesticides

- Plant protection products based on:
  - Living microbes.
  - Natural products: e.g. plant extracts (botanicals), insect sex pheromones etc.
- Regulatory authorization.
- Human & environmental safety. Residues.
- Efficacy, speed, persistence lower than synthetic chemical pesticides.

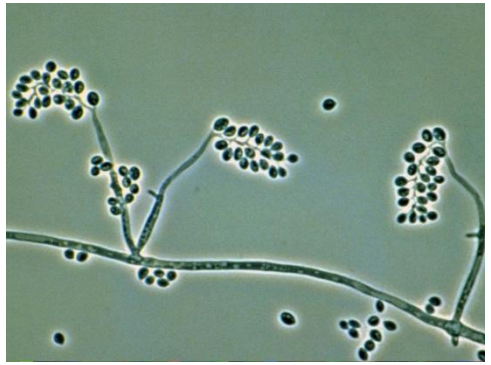
Biopesticides: examples

- ***Beauveria bassiana*** – fungal pathogen of whiteflies.
- ***Bacillus subtilis*** – bacterial control of Botrytis, powdery mildew, downy mildew.
- ***Chenopodium*** **terpenes** (essential oil) for control of spider mites.

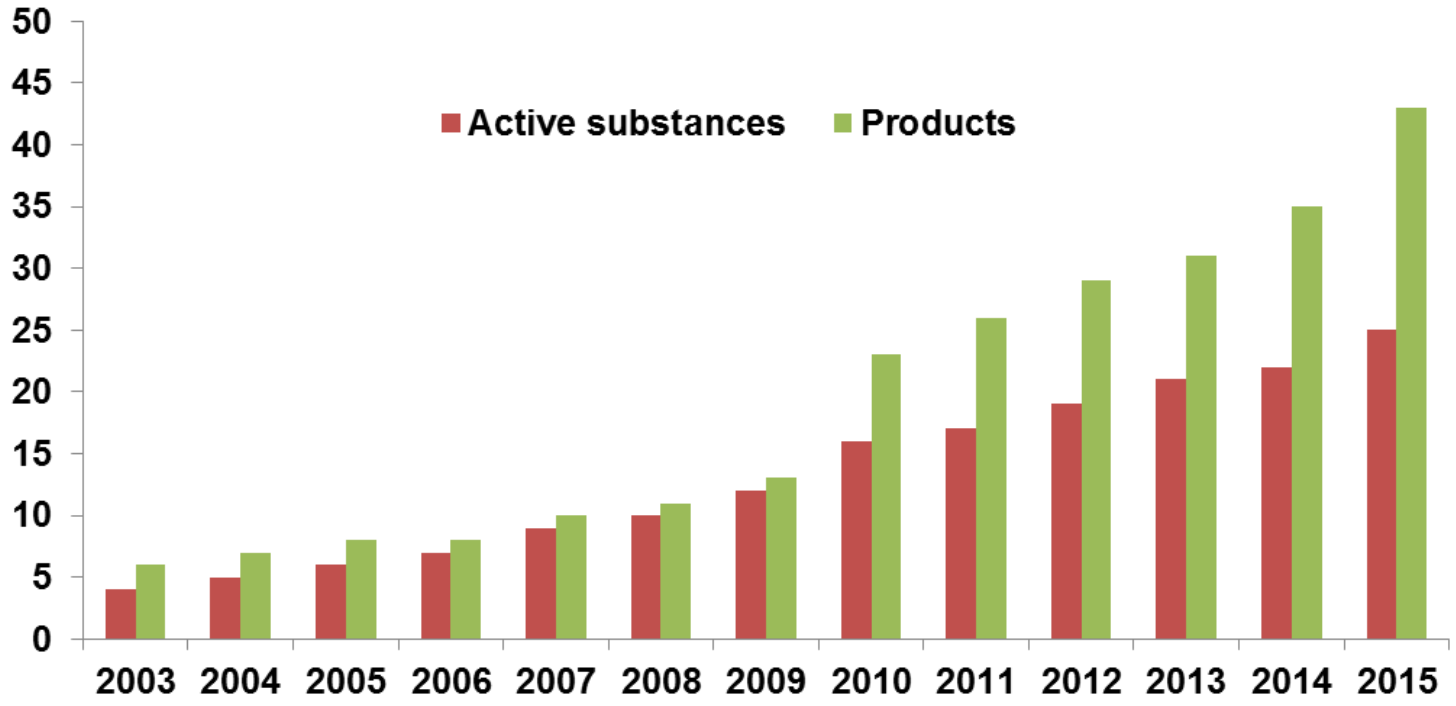


Biopesticides used as part of IPM

- Different IPM tools *working together* provide robust pest control.
  - Spider mites: Fungal pathogen as 2nd line of defence to predators.



Availability of biopesticides in the UK



Cumulative no. biopesticides in UK (2003-2015) CRD

Biopesticides: UK experience

- Growers want to use biopesticides. Increasingly important tool.
- Some products reliable. Others give inconsistent results.
- More knowledge needed with these new products.

The AHDB AMBER project

- **A**pplication & **M**anagement of **B**iopesticides for **E**fficacy and **R**eliability (Warwick, ADAS, Silsoe, RJ & RG).
- PE, PO & HNS crops.
- Identify the reasons why biopesticides can be inconsistent.
- Develop management tools and practices that can improve performance.

The AMBER challenge

- Capture the benefits of biopesticides and mitigate for their downsides.
- Do this by changing grower practice.
- Need generic tools & practices:
  - Different crop types.
  - Different P & D.
  - Different biopesticides.
- Evidence based.

AMBER: how it works

Benchmark biopesticide performance

Grower; manufacturers

Identify areas where performance could be improved

Design + evaluate improved practices

Extrapolate to wider range of crops

Knowledge Exchange

Biopesticide 'benchmarking'

- Observed how growers used microbial biopesticides as part of IPM, following product guidelines (commercial products).
  - Aphids, pepper.
  - WFT, chrysanthemum.
  - Whitefly, poinsettia.
  - Powdery mildew, cucumber.
  - Botrytis, cyclamen.
  - Root rots, Choisya & Dianthus.
- Data rich: Identify issues that were likely to affect biopesticide performance.


ROBUR

What did we observe?

- Benchmarked products varied in performance.
  - Microbial efficacy linked to pest population size.

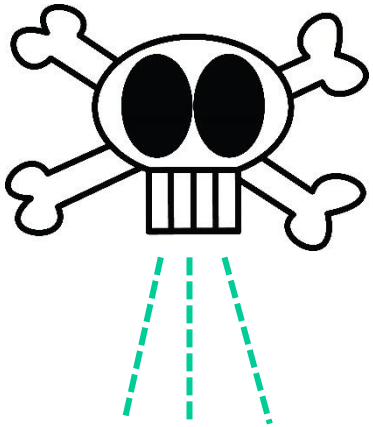
- Issues with application:
  - High volume (run-off; takes long time).
  - Improve the basics (KE).

- Effective dose – how much product do you want on the plant, where & when?

Effective application

(contact acting)

Right dose



Right place & time

Avoid waste

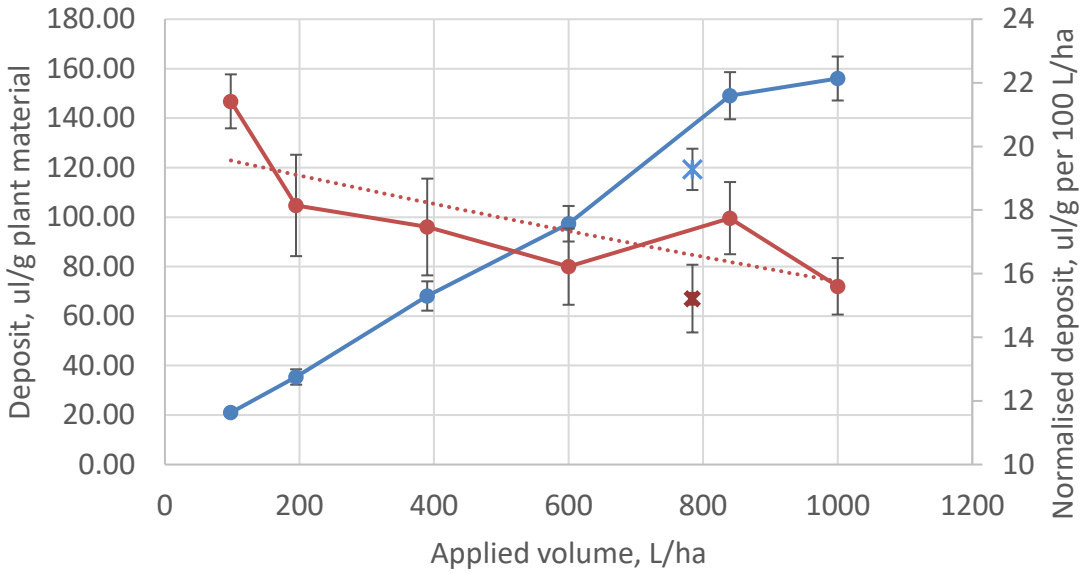
Biology of pest, disease & M.o.A. biopesticide

Environment; other IPM tools

Working in 4 areas

- Making spray application more efficient: relationship between water volume and % of spray retained on crop.
- Biofungicide performance: new knowledge on biofungicide persistence to improve timing of application.
- Bioinsecticide performance: new knowledge on how pest population growth rates influence biopesticide application strategy.
- Knowledge exchange: explain the science, get core message out.

Optimising spray water volumes

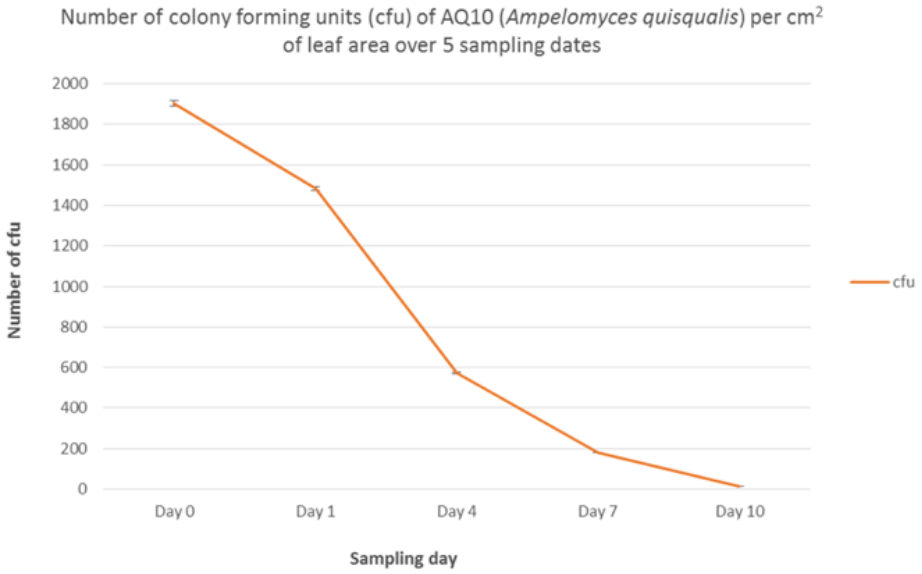


Deposit, fine spray

Deposit, coarse spray

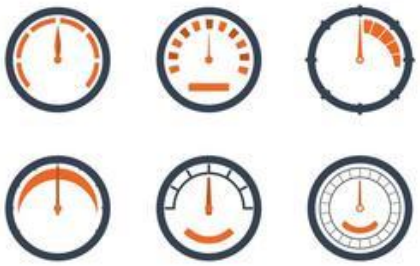
Normalised deposit, fine spray

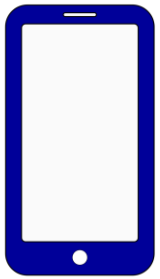
Normalised deposit, coarse spray



Powdery mildew control: Persistence of biofungicide AQ10 on foliage

Apply AQ10





On line Sensors (30 MHz):
Temp. / RH triggers PM alert

Boxcar model for pest development

- Unlike conventional pesticides, biopesticide efficacy depends on pest growth rate, reproduction & population size.
- But we can't predict the effects.
- New model - simulates no. of individuals at each life stage.
- Tracks the maturation of individuals to next life stage, reproduction & lifespan.
- Simulates applications of biopesticides and control efficacy (persistence, mortality & speed of kill).

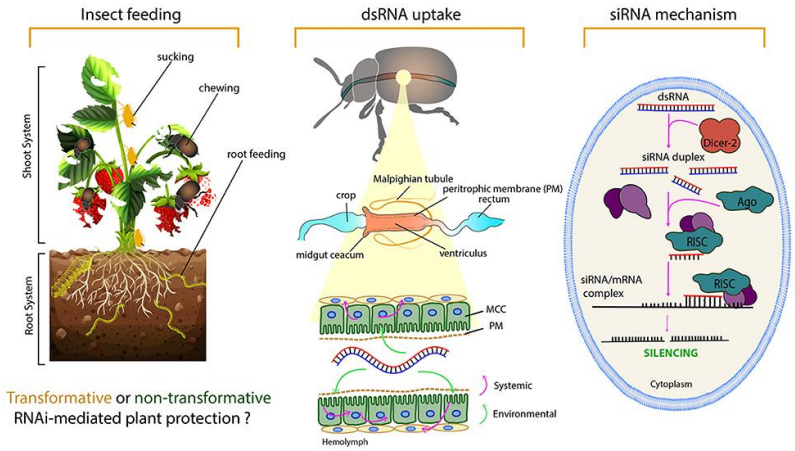
Biopesticides have potential in IPM:

- Understand the product – how it works, compatibility, how to store & apply.
- Invest in training.
- Don't have false expectations. Use at low P&D pressure as part of IPM.
- Good spray application is vital:
  - calibrate, change nozzles, sprayer MOT.
  - Reduced volume (but not reduced dose) maximises amount on leaves. Buy a decent sprayer.

The future: new biologically based products

- Microbes + metabolites:
  - Grandevo (Marrone): *Chromobacterium subtsugae* – whitefly, mites, caterpillars.

- RNAi mediated silencing of gene expression:
  - Exogenous dsRNA



Frontiers in Physiology, 7, 553

But we must avoid ‘silver bullets’!

IPM not IBM

AMBER

Thankyou

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