

Advances in Bioprotection Formulations and use of Sustainable Co-Formulants

Dr David Calvert

iFormulate Limited

ABIM

Basel 23rd October 2019



Agenda

- Introductions
- Formulation
- Biopesticide Formulations
 - Past
 - Present
 - Future
- “Sustainable Co-Formulants”
- Summary

A Little About iFormulate

Founded in 2012 by
two experienced
industry professionals

Diverse experiences,
knowledge and wide
range of contacts

Polymers, materials science,
chemistry, imaging, dyes, pigments,
emulsion polymerisation, biocides,
pharma, agrochem, FMCG, food,
anti-counterfeiting, environmental,
formulation etc...

Consultancy, innovation, marketing,
business development, strategy,
regulatory, training, events, R&D

Complementary
Network of
Associates

W: www.iformulate.biz

E: info@iformulate.biz

Dr Jim Bullock

E: jim@iformulate.biz

M: +44 (0)7450 436515

Dr David Calvert

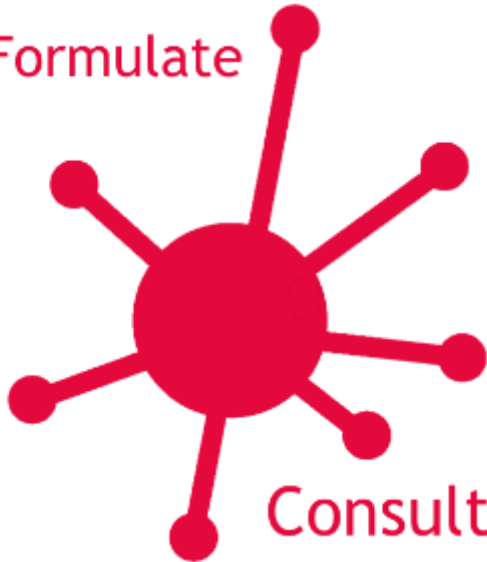
E: david@iformulate.biz

M: +44 (0)7860 519582

 **iFormulate**

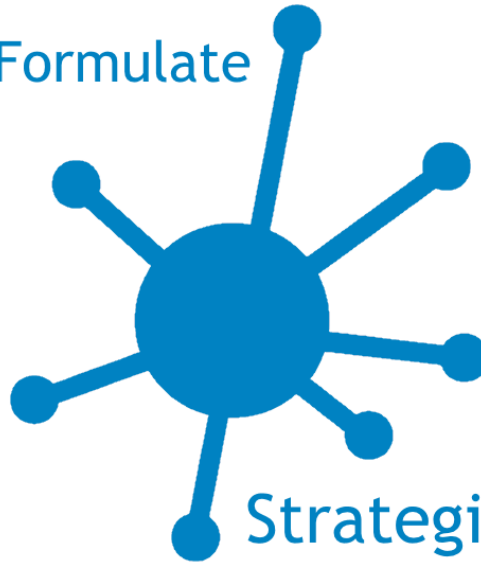
Our Services

iFormulate



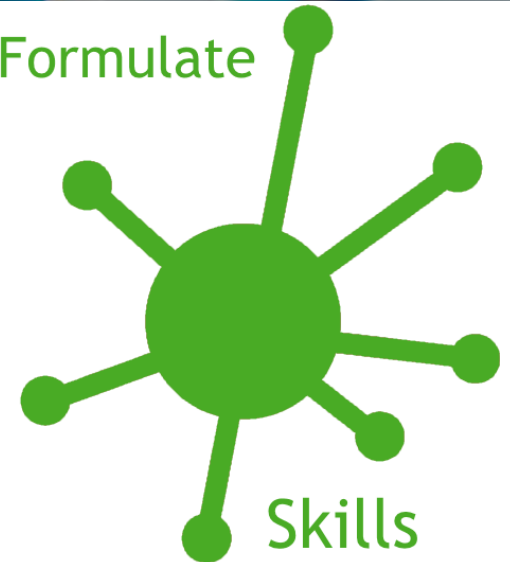
Consult

iFormulate



Strategic

iFormulate



Skills

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FORMULATION



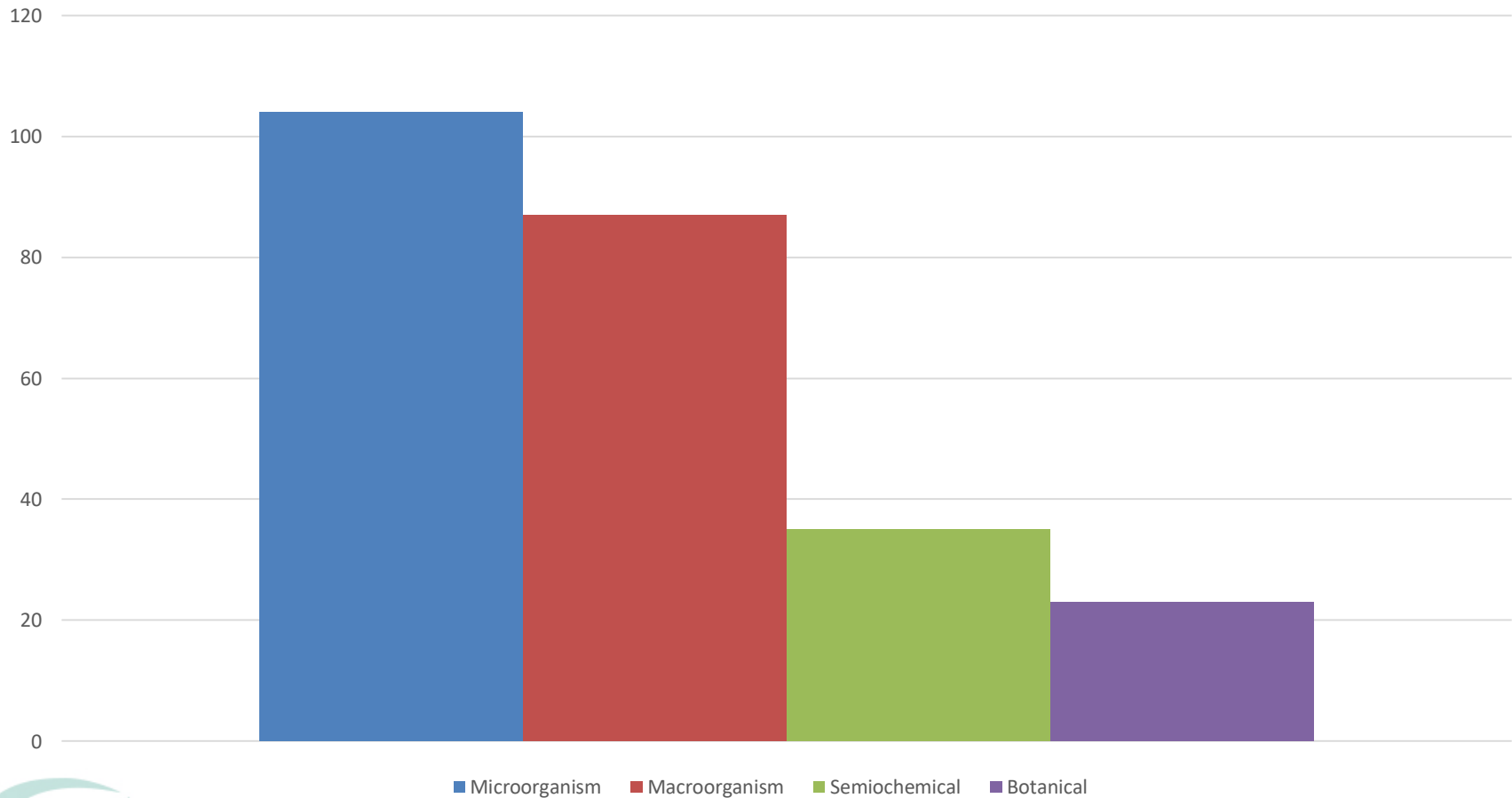
What is Formulation?

- A **composition or recipe** comprising an active ingredient (chemical, biochemical or biological) and other ingredients (often called formulants, co-formulants or inerts).
- A **process of combining** the active ingredient with the other ingredients to create a useable product. In most cases good formulation requires not only combining the various ingredients but also creating within the product a suitable microscopic physical structure (microstructure) which gives the product many of its desired properties.
- The finished (formulated) **end-use product** itself may be called a formulation.

Water Compatible Formulation Types*

Formulation Type	Physical Form of Product	Active Soluble in Water?	Solid or Liquid Active?	Suitable for Water Sensitive Active?	Suitable for Living Actives?	Suitable for Bio- Extracts etc
EC	Liquid	No	Either	Yes	No	Yes
SC	Liquid	No	Solid	No	Yes	Yes
EW	Liquid	No	Either	No	No	Yes
SL	Liquid	Yes	Either	No	No	Yes
OD	Liquid	Yes/No	Solid	Yes	Yes	Yes
CS	Liquid	Yes/No	Either	Yes	Yes	Yes
ME	Liquid	No	Either	No	No	Yes
SE	Liquid	No	Both	No	Yes	Yes
WP	Solid	No	Solid	Yes	Yes	Yes
WG	Solid	No	Solid	Possibly	Yes	Yes

Category of Biocontrol agents*

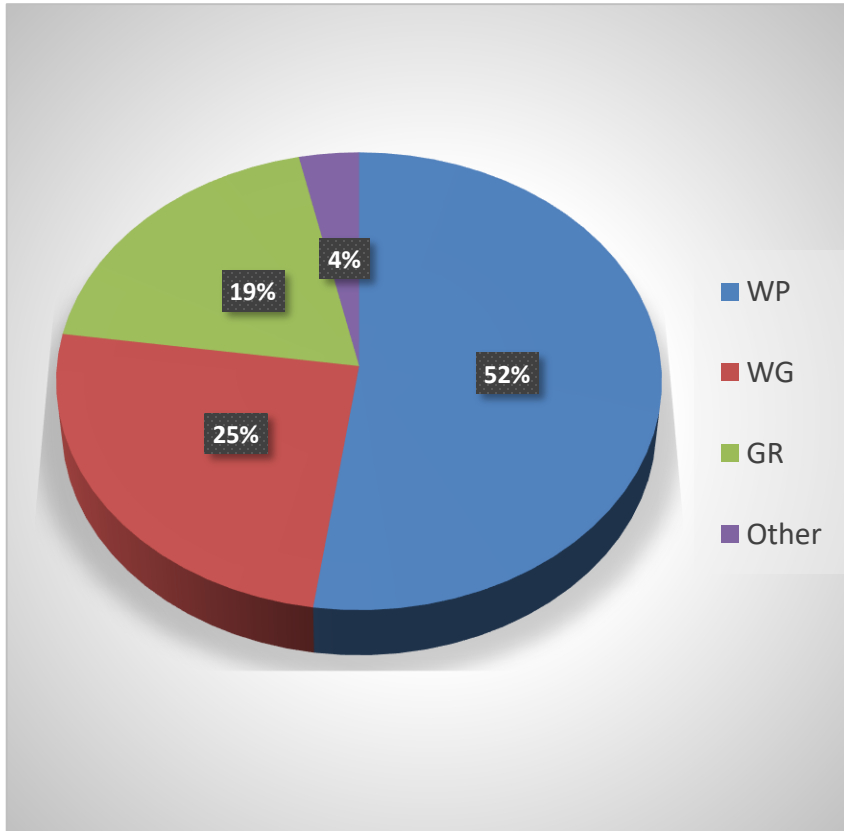


BIOCONTROL AGENTS FORMULATIONS

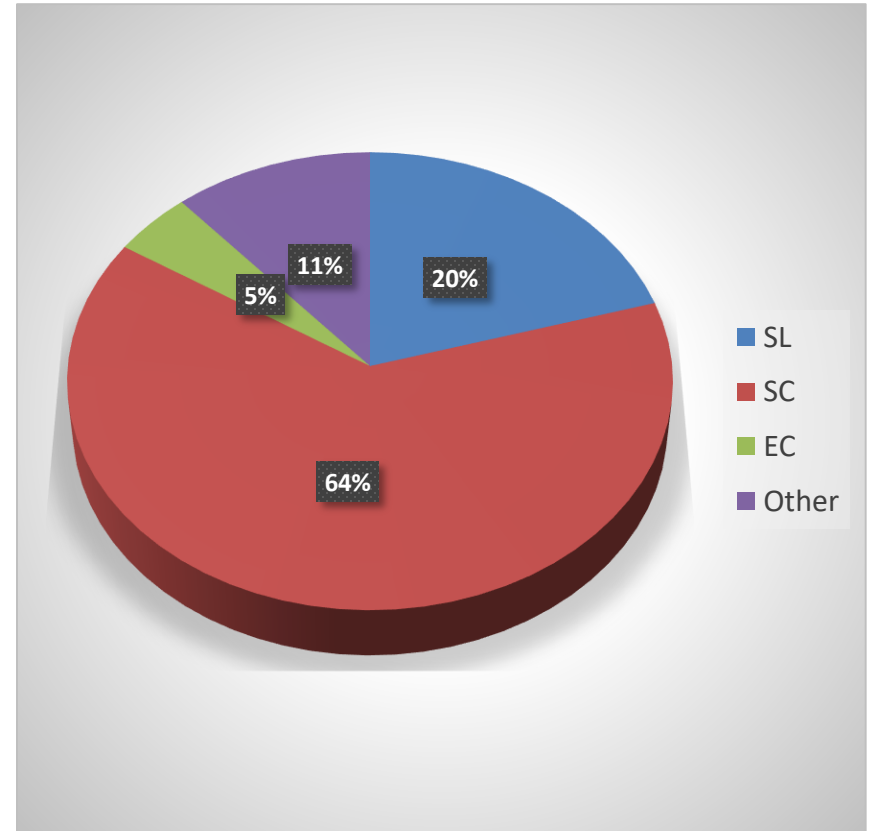


Microorganism Formulation Past*

Solids (88)



Liquids (44)

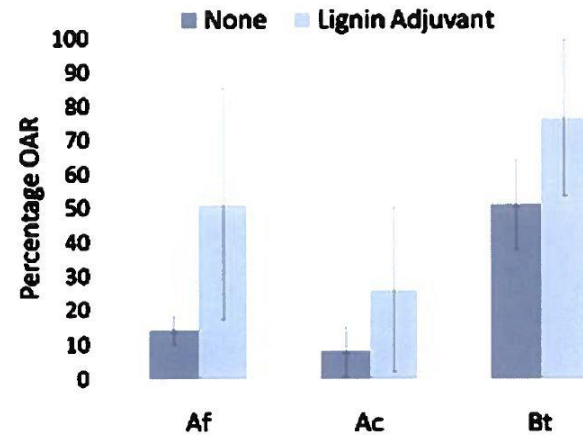


Microorganism Formulation Present

- 29 products based on microorganisms launched in last four years based on new actives
 - Biopesticides 2018 Agrow report
- 17 liquid formulation products
 - Dominated by SC (13 products)
- 12 solid formulation products
 - Still dominated by WP (8 products)

UV resistance of Biopesticides

- Lignin spray dried to form granules
- Added to spray mixture with calcium chloride (crosslinker)
- Original Activity Remaining (OAR) measured two days after application
- Two Baculoviruses and commercial Bt product



Journal of ASTM International, Vol. 8, No. 1
Paper ID JAI102793
Available online at www.astm.org

Robert W. Behle,¹ David L. Compton,² James A. Kenar,² and David I. Shapiro-Ilan³

Improving Formulations for Biopesticides: Enhanced UV Protection for Beneficial Microbes

Future

- New formulation types will be used to solve problems/provide new products
 - Combination products
 - More stable products
 - More cost-effective treatments

Combination Products

- Different pesticides with different Modes of Action (MoA) needed to prevent development of resistance
- Often biopesticides are rotated with conventional pesticides as part of Integrated Pest Management (IPM)
- Can you combine in one treatment?

Combination Products

Regev™

- STK Group Tea Tree Oil combined with chemical pesticides
- Initially Difenoconazole
 - Many more claimed in patent WO2013068961
- Oil in Water emulsion
- Different emulsifiers claimed

PONCHO®/VOTIVO®

- Seed Treatment from BASF
- *Bacillus firmus* and Clothianidin
 - PONCHO alone contains 8% glycerine and 2.25% Fatty alcohol ethoxylate (Liquid Suspension)
- Other Ingredients >50%
- Applied as a water based slurry with dye to seed
- 2.0 contains two strains of Bt

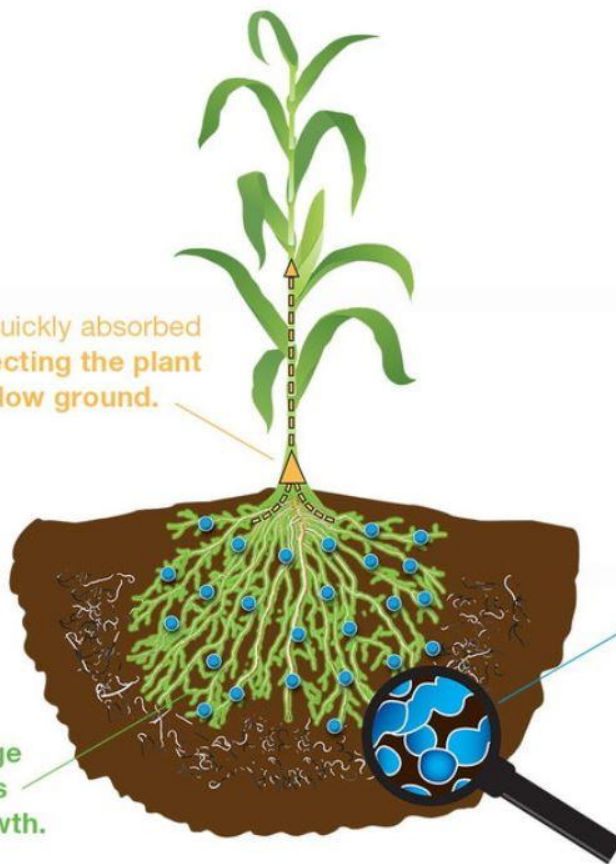
PONCHO®/VOTiVO® 2.0*

PONCHO®

The systemic insecticide is quickly absorbed through the new roots, protecting the plant from insects above and below ground.

VOTiVO®

A distinctive bacteria strain creates a living barrier that prevents damage from plant pathogenic nematodes and promotes root and plant growth.



2.0

A second, complementary bacteria increases the productivity of soil around the root, resulting in an increase of available nutrients for the plant to use.



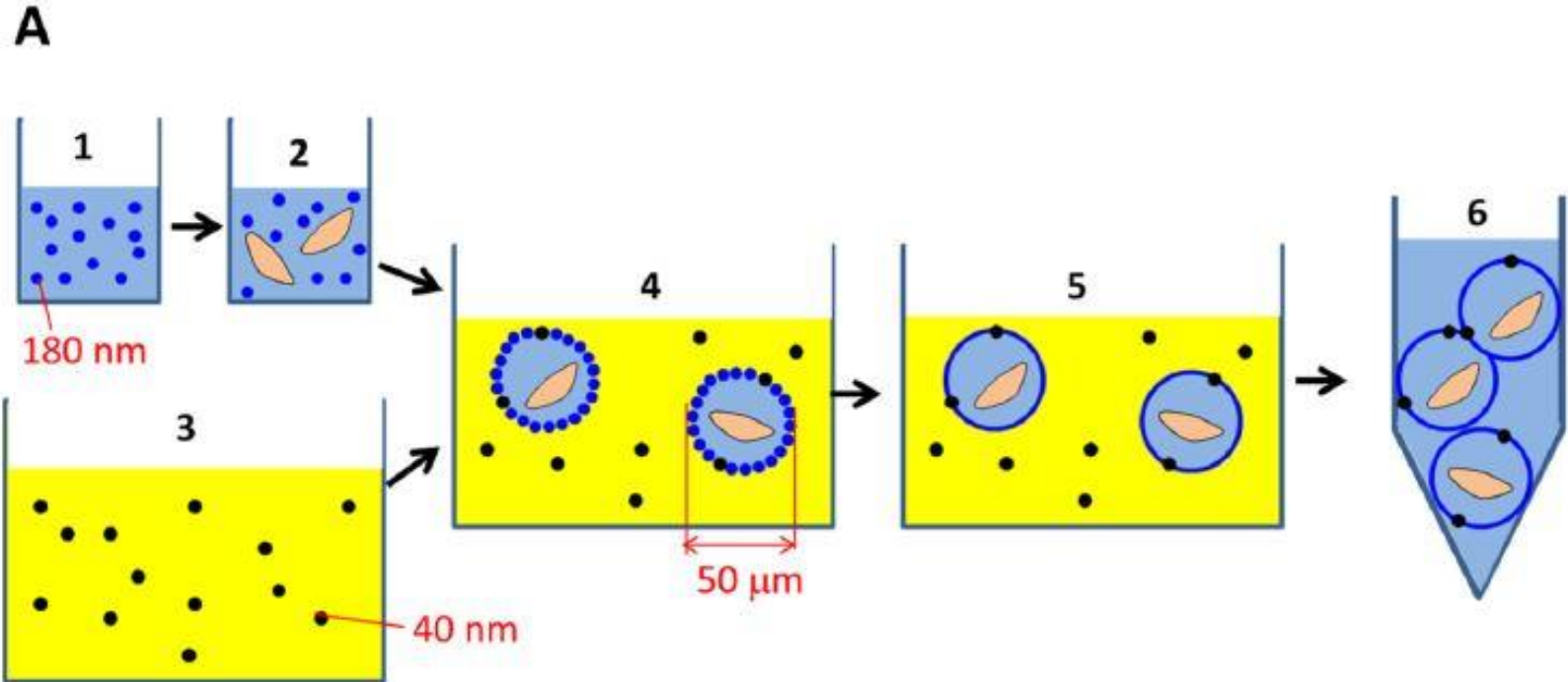
ABIM®

Annual Biocontrol Industry Meeting®

*<https://agriculture.basf.com/us/en/Crop-Protection/Poncho-VOTiVO-2-0.html>



Pickering Emulsions/Encapsulation*



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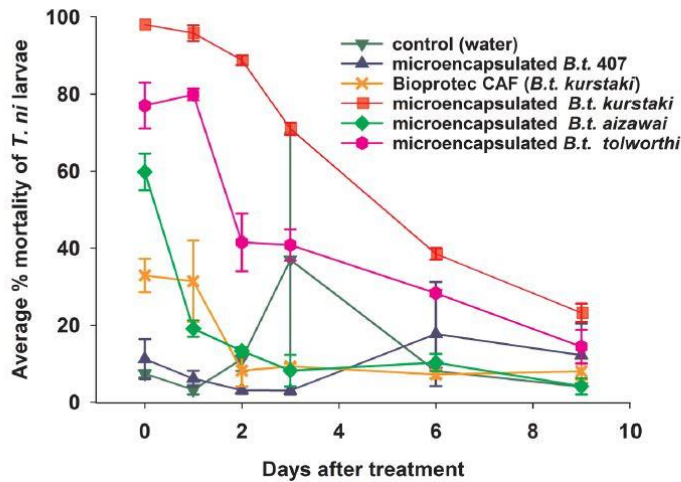
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*Bashir et al. (2016), Controlled-release of *Bacillus thuringiensis* formulations encapsulated in light-resistant colloidosomal microcapsules for the management of lepidopteran pests of Brassica crops. PeerJ 4:e2524; DOI 10.7717/peerj.2524

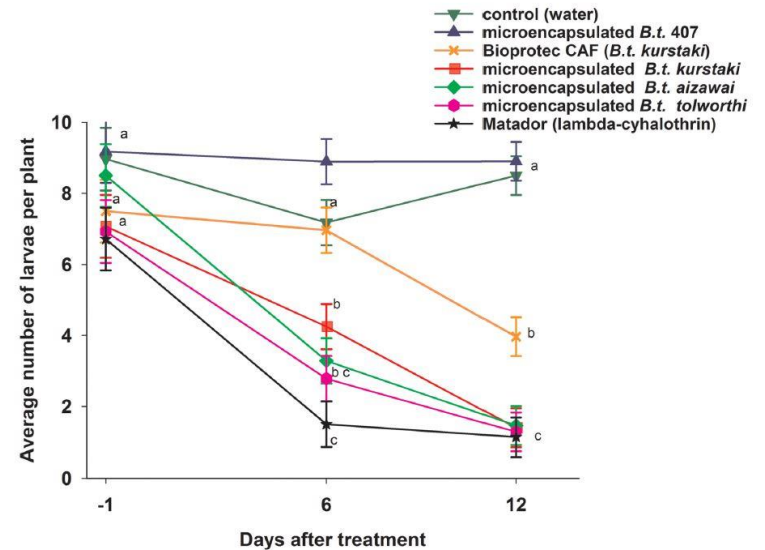


Encapsulated Bt*

Persistence



Field Trial Efficacy



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Annual Biocontrol Industry Meeting[®]

Bashir et al. (2016), Controlled-release of *Bacillus thuringiensis* formulations encapsulated in light-resistant colloidosomal microcapsules for the management of lepidopteran pests of Brassica crops. PeerJ 4:e2524; DOI 10.7717/peerj.2524



Future Formulation Possibilities

[0045] The substances set forth above used in the compositions and methods disclosed herein can be formulated in any manner. Non-limiting formulation examples include but are not limited to Emulsifiable concentrates (EC), Wettable powders (WP), soluble liquids (SL), Aerosols, Ultra-low volume concentrate solutions (ULV), Soluble powders (SP), Microencapsulation, Water dispersed Granules, Flowables (FL), Microemulsions (ME), Nano-emulsions (NE), and Seed treatments etc. In any formulation described herein, percent of the active ingredient is within a range of 0.01% to 99.99%.

Applicant: Marrone Bio
Innovations Inc.

US 2019/0069556 A1
Published Mar 7 2019
“Use of Burkholderia
Formulations,
Compositions and
Compounds to Modulate
Crop Yield and/or Corn
Rootworm Infestation”

[0046] The compositions can be in the form of a liquid, gel or solid. Liquid compositions comprise pesticidal compounds derived from a *Burkholderia* sp strain, e.g. a strain having the identifying characteristics of *Burkholderia* A396 (NRRL Accession No. B-50319).

Adjuvants

- In-Can or Spray tank
- Bring Performance Benefits
 - Spray Drift Minimisation
 - Penetration Enhancement
 - Rain Resistance
 - Leaf Adherence
- Widely used with “conventional pesticides”
- “No known Adjuvants”
 - Common phrase in BCPC’s Manual of Biocontrol Agents
- OMRI Web-site
 - 34 approved classed as adjuvants
 - Spreaders, wetters, stickers, humectant, spray adjuvant
 - Scope for many more

“Bio-Adjuvants?”

- Croda
 - Established range of Surfactants “Tweens®” “Spans®” etc
 - New Eco-Range
 - 100% renewable
 - 100% bio-based ethylene oxide (EO)
 - ECO Tween® 26% lower carbon footprint
- Global Adjuvants Company
 - ECO-FP ECO-Tac
 - Contains Apraffin wax and other food safe components
 - Improves Spreading, retention and penetration of actives
 - UK approval for organic farming, European Ecocert and NOP in North America

Summary

- Biopesticide formulations are at an early stage
- Standard formulation types being used mainly
- Performance advantages will come from formulation
- Combination products will rely upon formulation science
- Adjuvants/Co-formulants will be key

Interested in learning more?

- Beginners Guide to Agrochemical Formulation Strategies
 - In-person 5th-6th November London
 - ATI On-line academy
 - <http://www.ati-global.co.uk/event/agrochemical-formulationoa>
- Applying Design Principles to Agrochemical Formulations
 - ATI On-Line academy
 - <http://www.ati-global.co.uk/event/applying-design-principles-to-agrochemical-formulations>
- Formulation of Biopesticides Agrow Report
 - Early 2020, contact Alan Bullion (Alan.Bullion@informa.com)
- Design of Experiments for Formulators
 - East Midlands December 3rd and 4th 2019
 - <https://iformulate.biz/doe-for-formulators-2019/>

Contact Us



Dr David Calvert
david@iformulate.biz
Tel: 07860 519582



Dr Jim Bullock
jim@iformulate.biz
Tel: 07450 436515

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