

# 2022 FLYSTRIKE RD&E TECHNICAL FORUM

Nanotechnology for flystrike control

Peter James – University of Queensland

10 August 2022



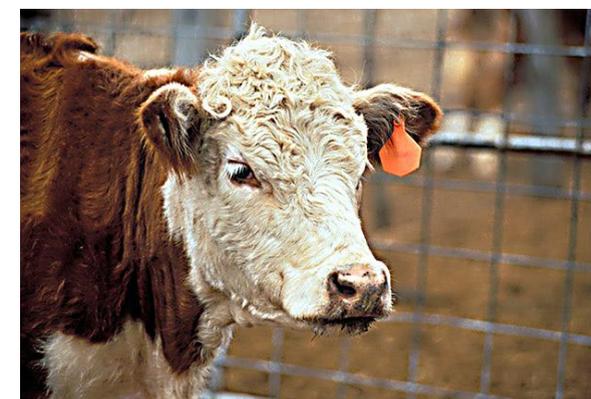
# Insecticidal control of flystrike

- Mainstay of integrated flystrike control program
- Practical requirement for prolonged periods of protection
- Effective long term protection required to reduce reliance on mulesing
- Reduced development of new chemistries for flystrike control
- Resistance - cyromazine and dicylanil
- Range of chemistries required for resistance management



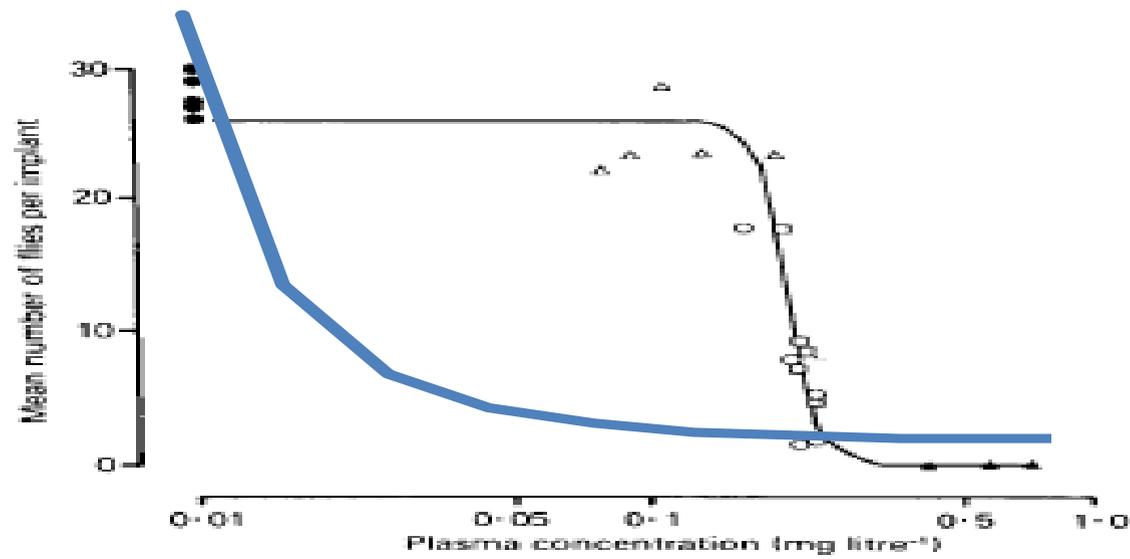
# Increasing use of controlled release technology to give extended period of protection against parasites

- Long acting injectable formulations
- Polymer matrix dog collars
- Insecticidal ear tags
- Rumen capsules



# Controlled release or strategic release for flystrike control?

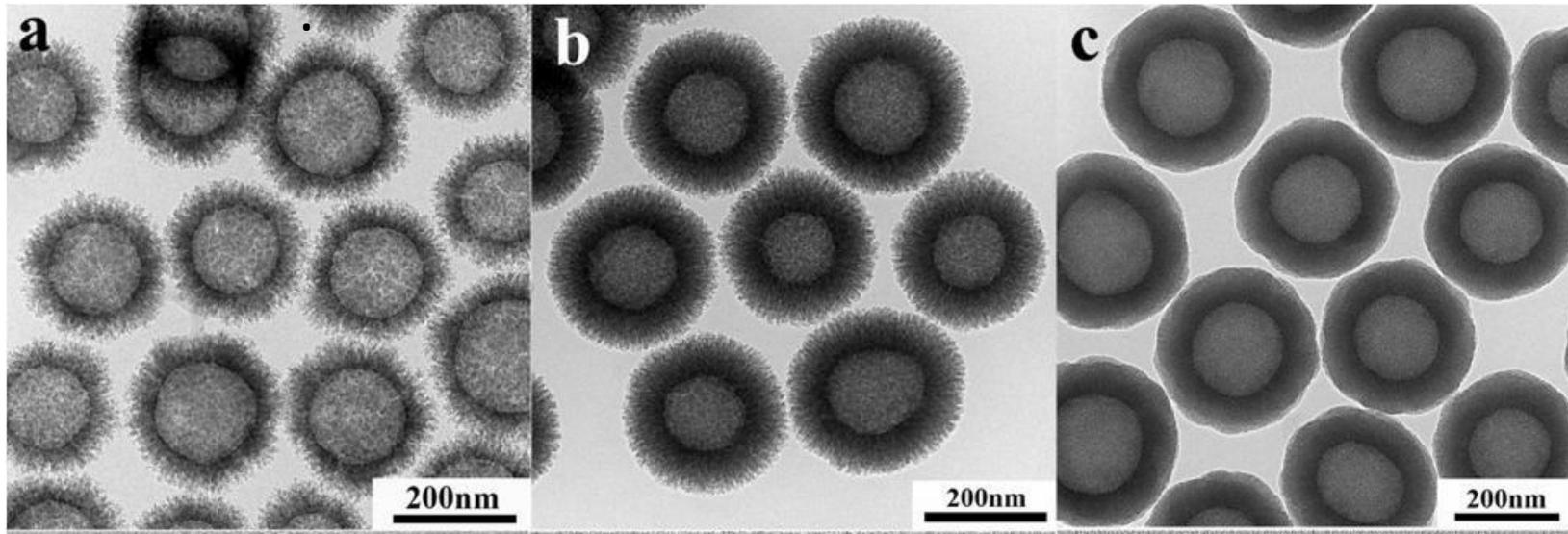
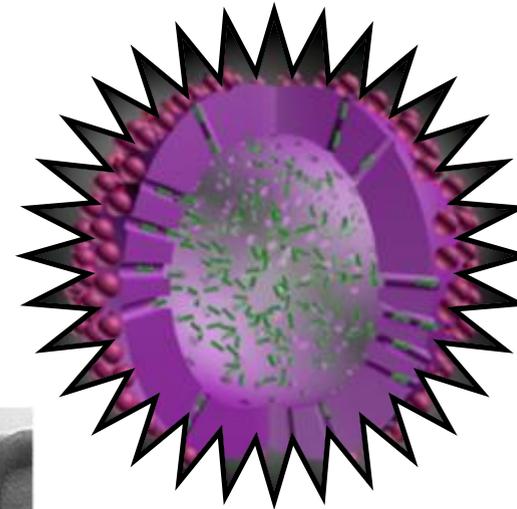
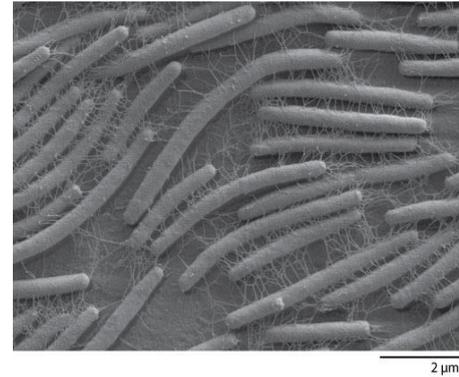
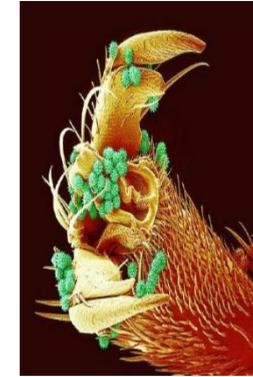
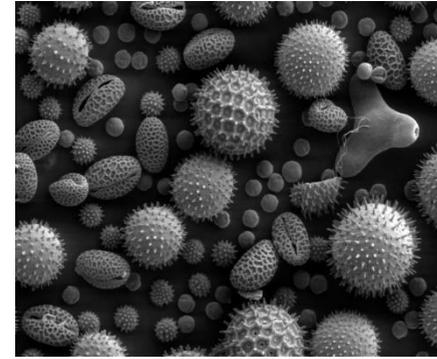
- Cyromazine 'square release curve' from capsule (Anderson et al. (1989) *Res.Vet. Sci.* 46: 131)
- Ivermectin capsules (Rugg et al. (1998) *Aust. Vet. J.* 76:350)
- Polymer tags for poll strike control
- Starch xanthate (particulate starch xanthate strategic release for flystrike control (James et al. (1994) *Vet Parasitol.* 52:113 /WRDC DAS11)



# UQ Nanoparticles

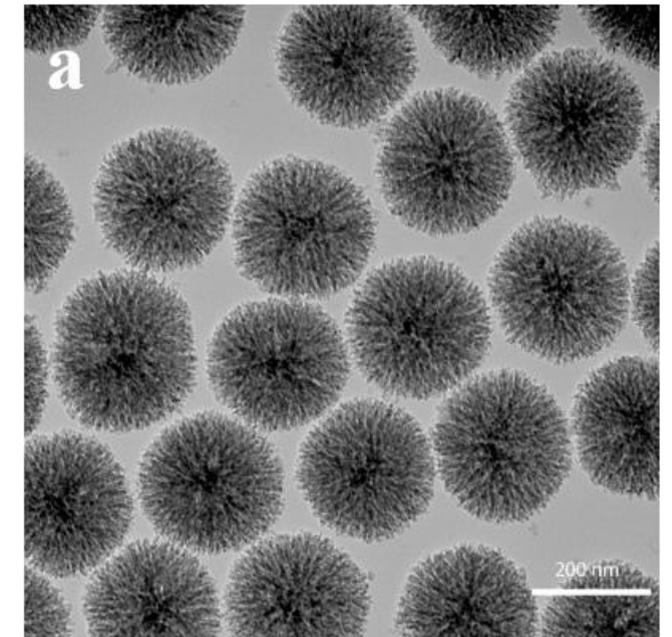
A solution learnt from nature:  
Particles with rough surface enhance adhesion and delivery

- 100 % pure silica ( $\text{SiO}_2$ , silicon dioxide)
- Hollow, porous shell to carry active (AI) inside
- Surface whiskers adhere to various surfaces
- NP here were 180-800 nm  
(1 nanometre = 1 millionth of a mm,  
1 thousandth of a micron)
- 'Tunable' construction



Rough nanoparticles

Smooth nanoparticles



FSN nanoparticles

# Nanoparticle studies

- Prolonged protection
- Strategic release

## Methods

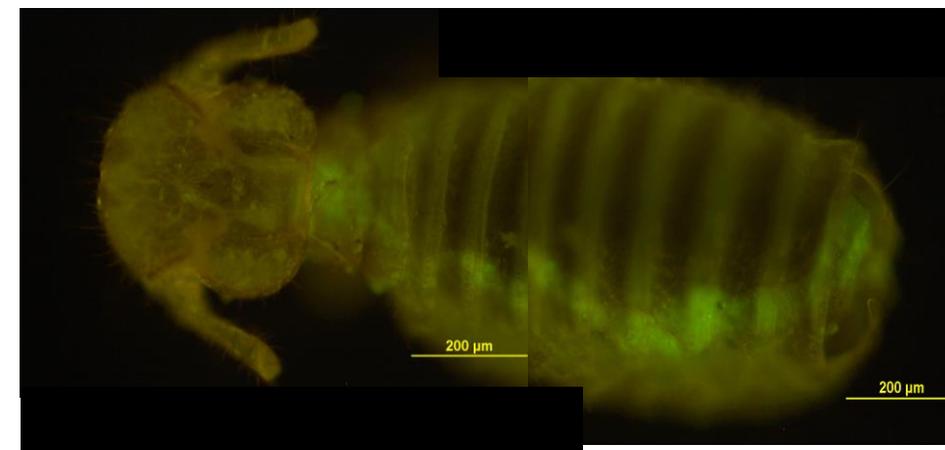
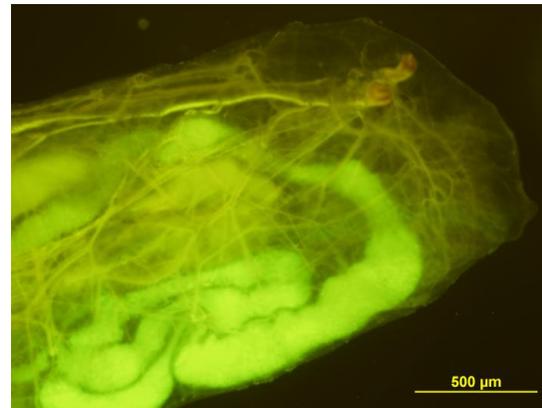
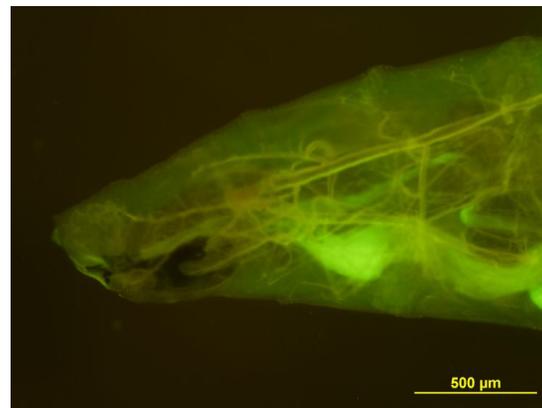
- Different types of particles, compared with 'traditional' commercial formulations
- Applied to wool
- Tested UV breakdown, water leaching
- Artificial and natural weathering tests
- Weathering on sheep
- Efficacy tested with laboratory assays against sheep blowfly maggots



Artificial weathering

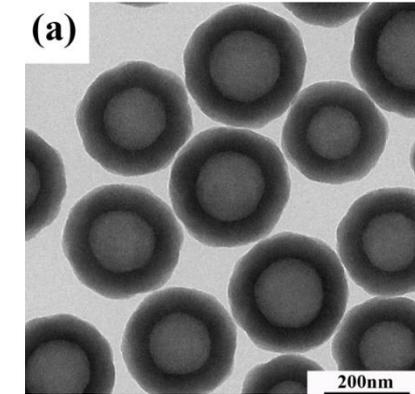
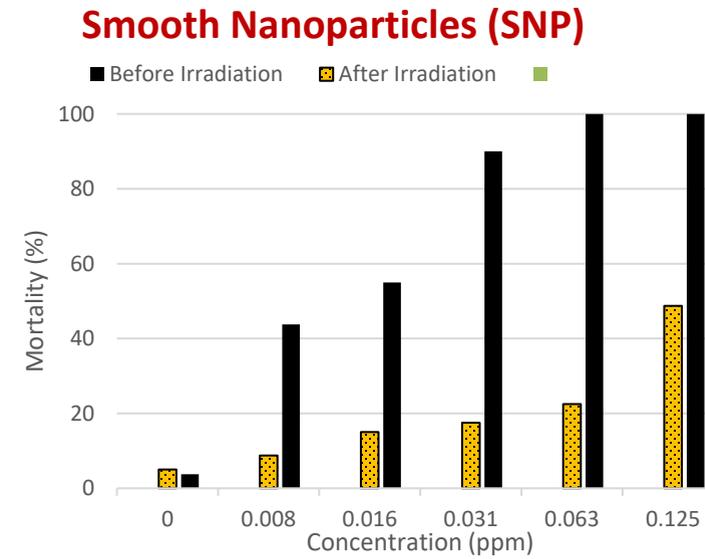
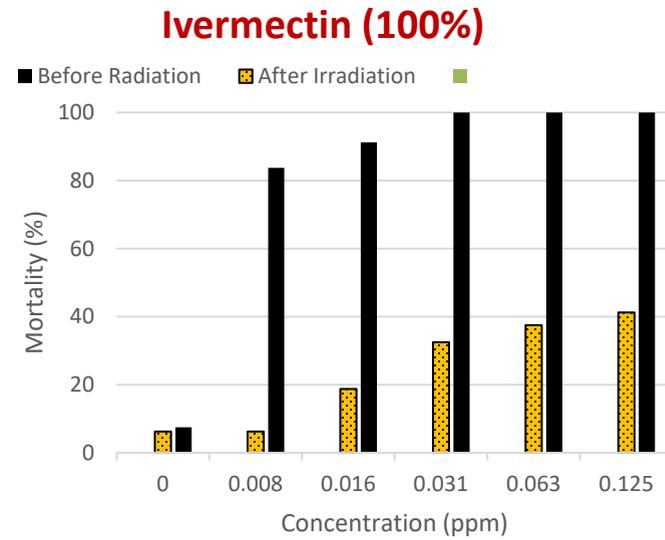


Weathering on sheep

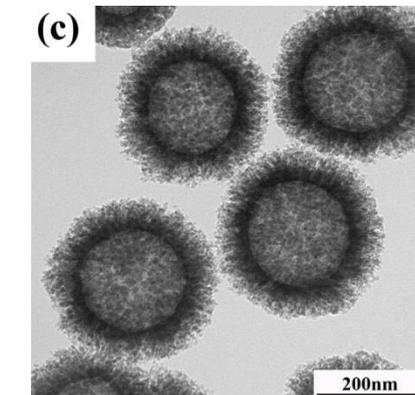
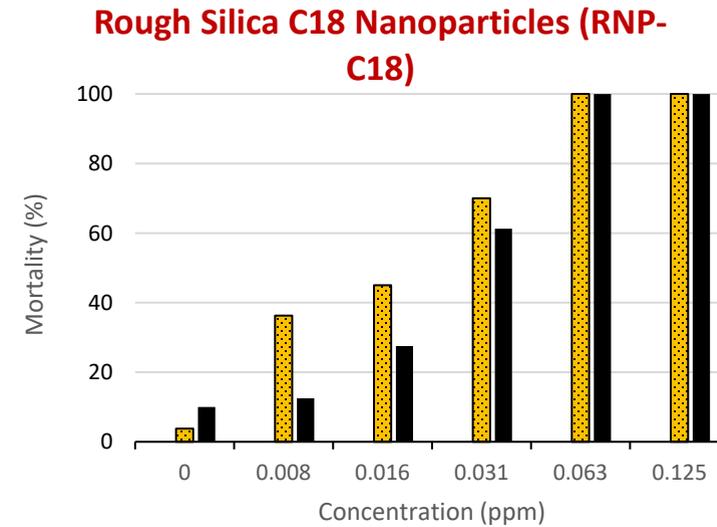
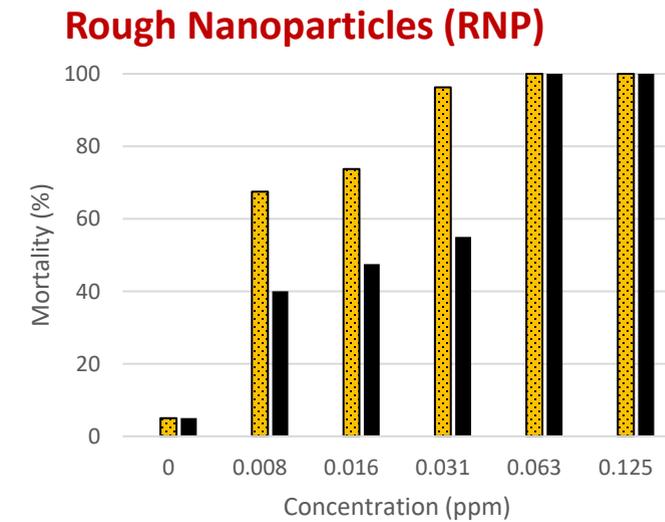


Fluorescent nanoparticles in the gut of blowfly maggots and lice

# UV weathering, ivermectin nanoparticles – larval bioassays

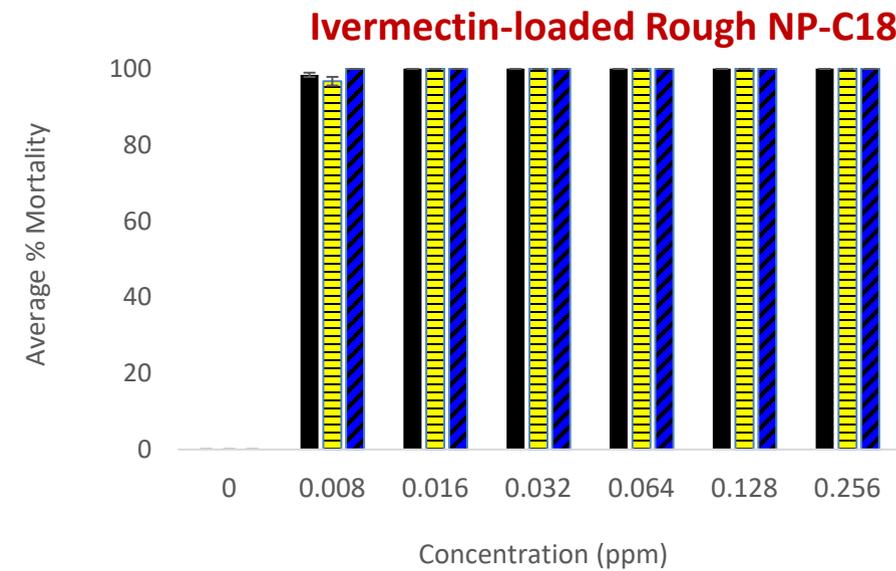
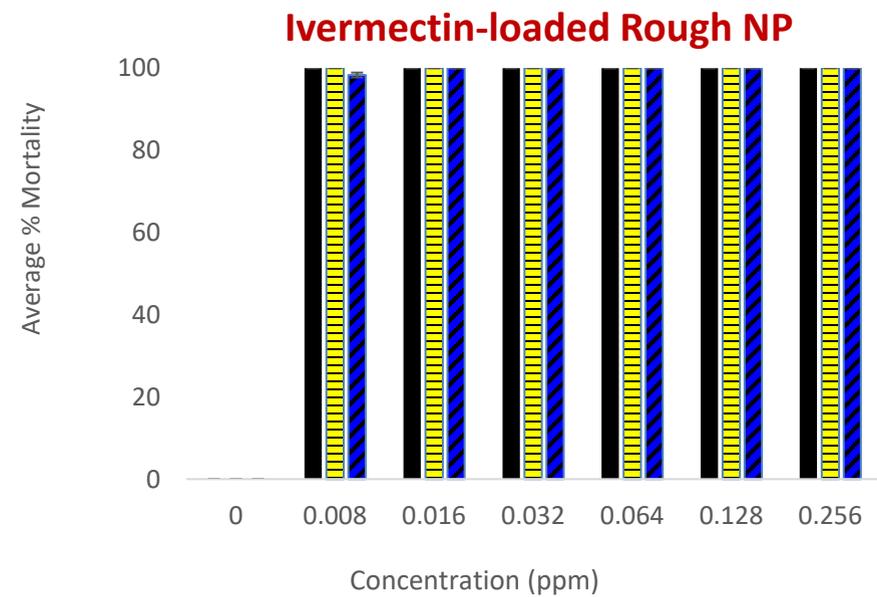
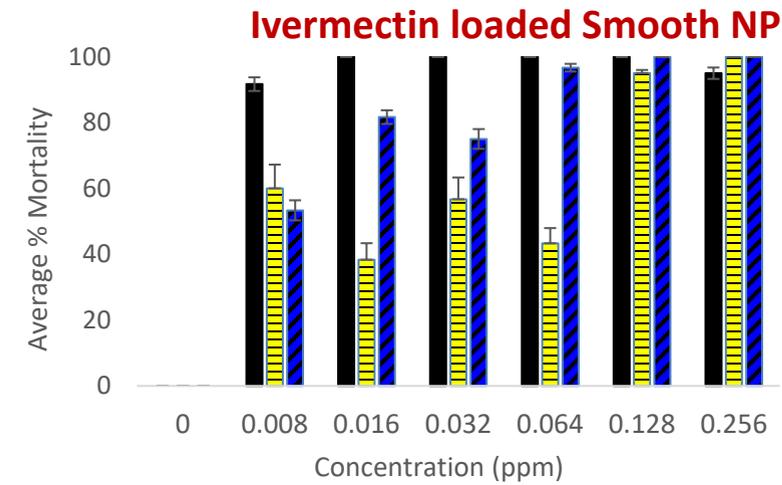
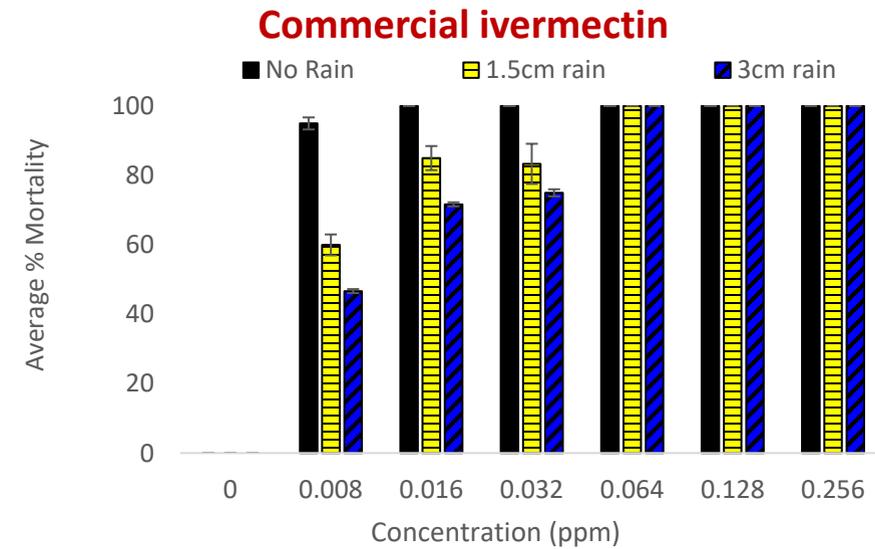


Smooth



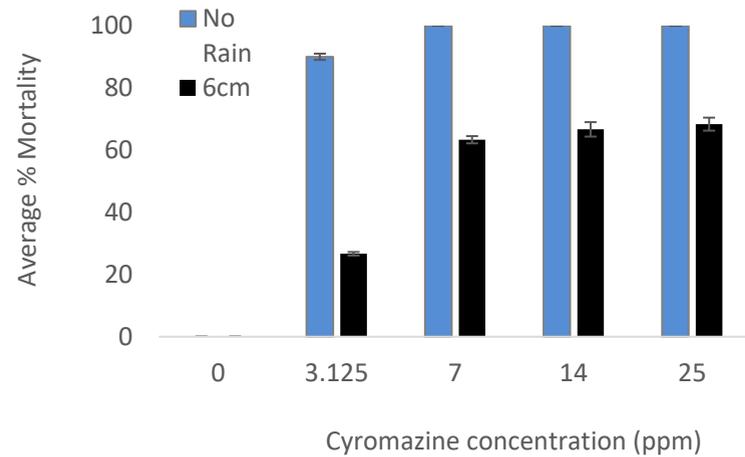
Rough

# Water fastness of ivermectin under artificial rainfall

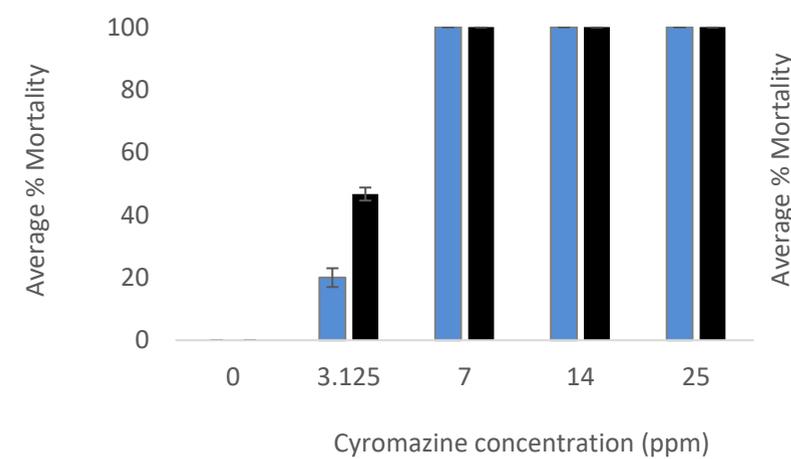


# Cyromazine nanoparticles – Artificial rain on two occasions

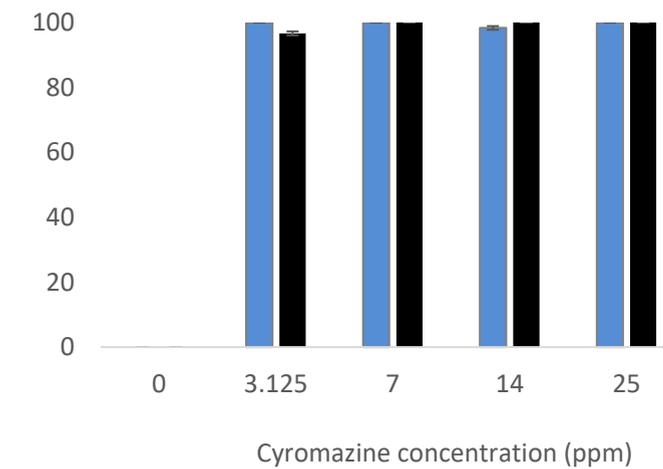
**Commercial formulation**



**Rough NP**

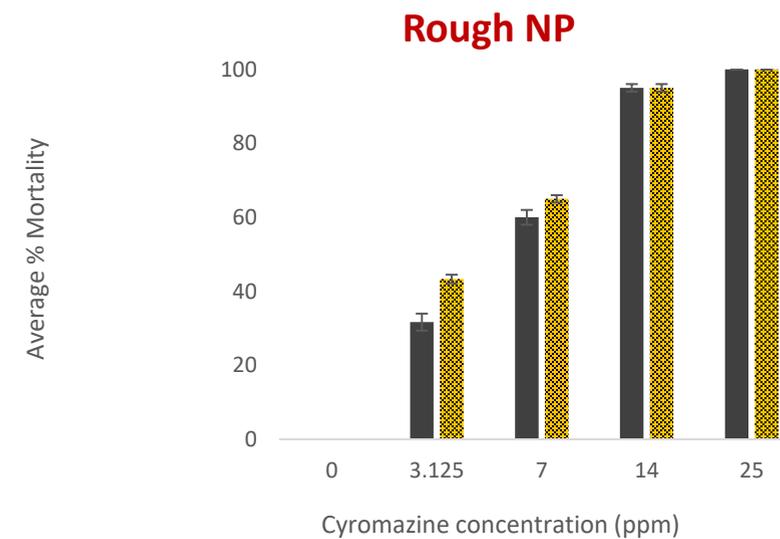
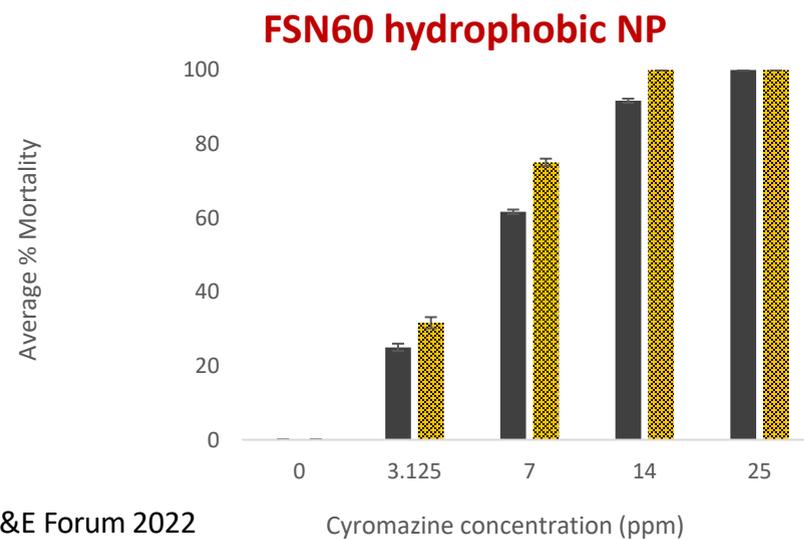
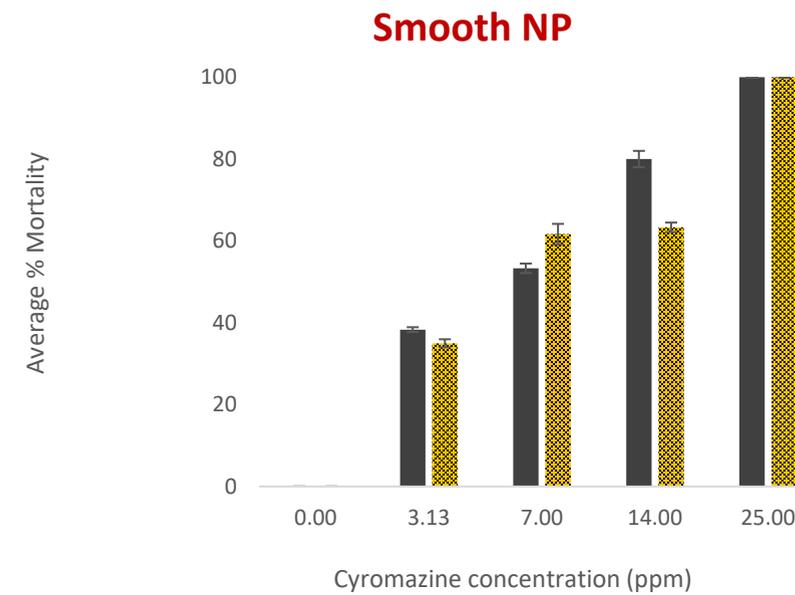
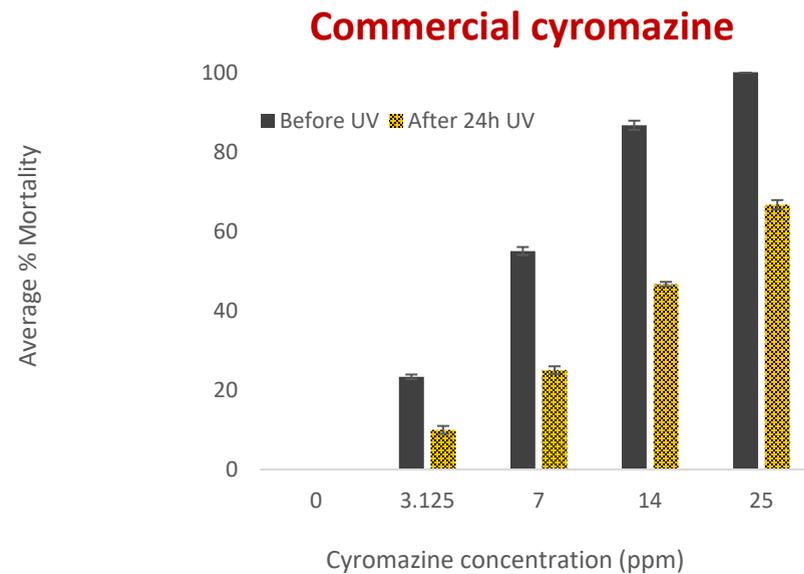


**FSN60 NP**

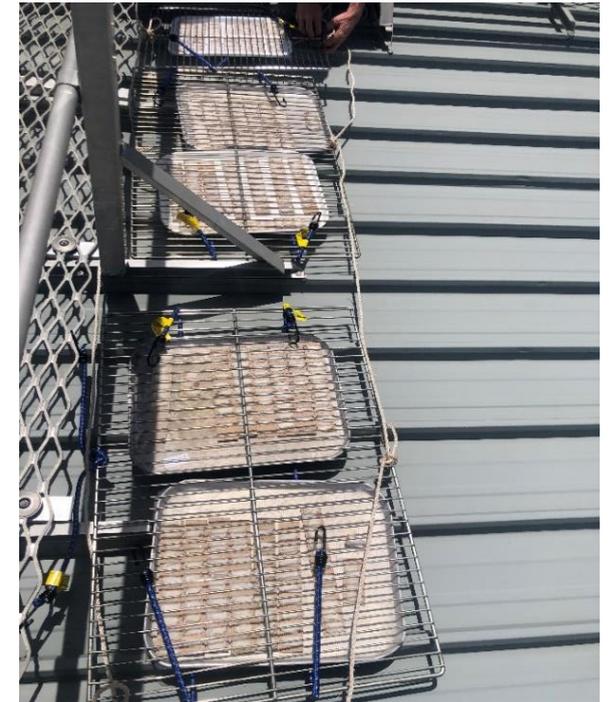
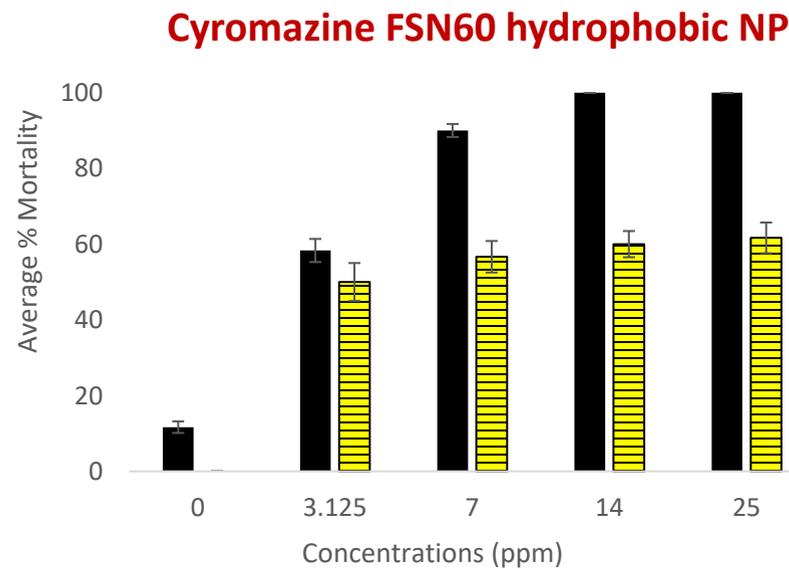
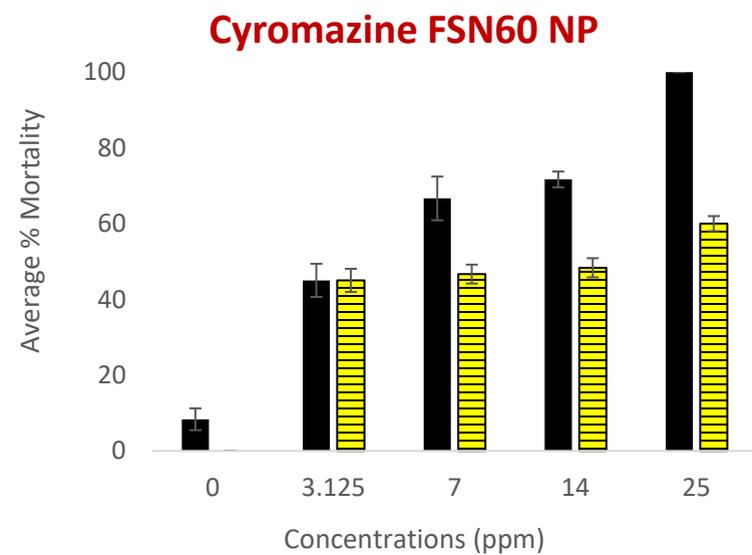
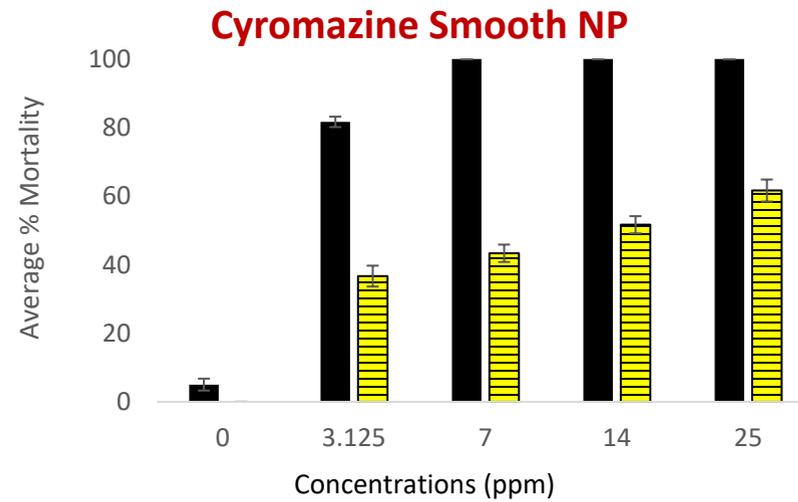
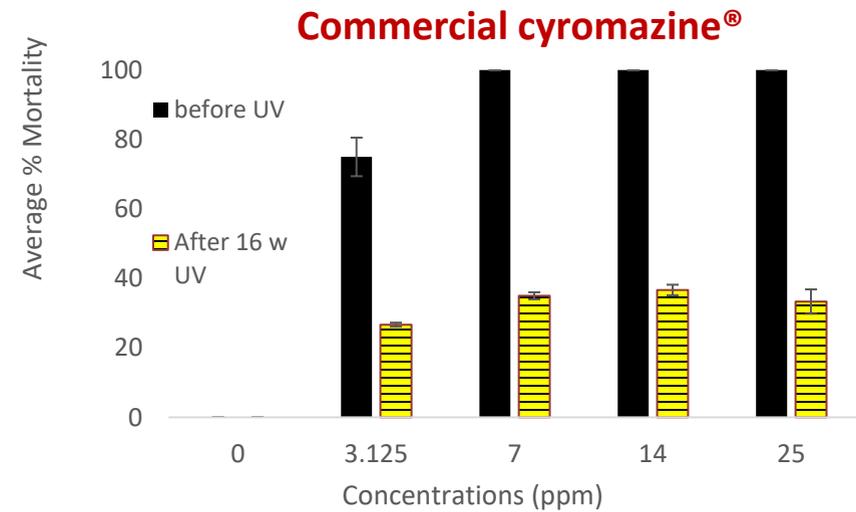


**\* Larval toxicity in assays for rain fastness with wool treated with different formulations of cyromazine, then exposed to simulated rainfall on two occasions**

# Effect of exposure to ultra-violet radiation on efficacy of nanoparticle and commercial formulations of cyromazine in larval assays

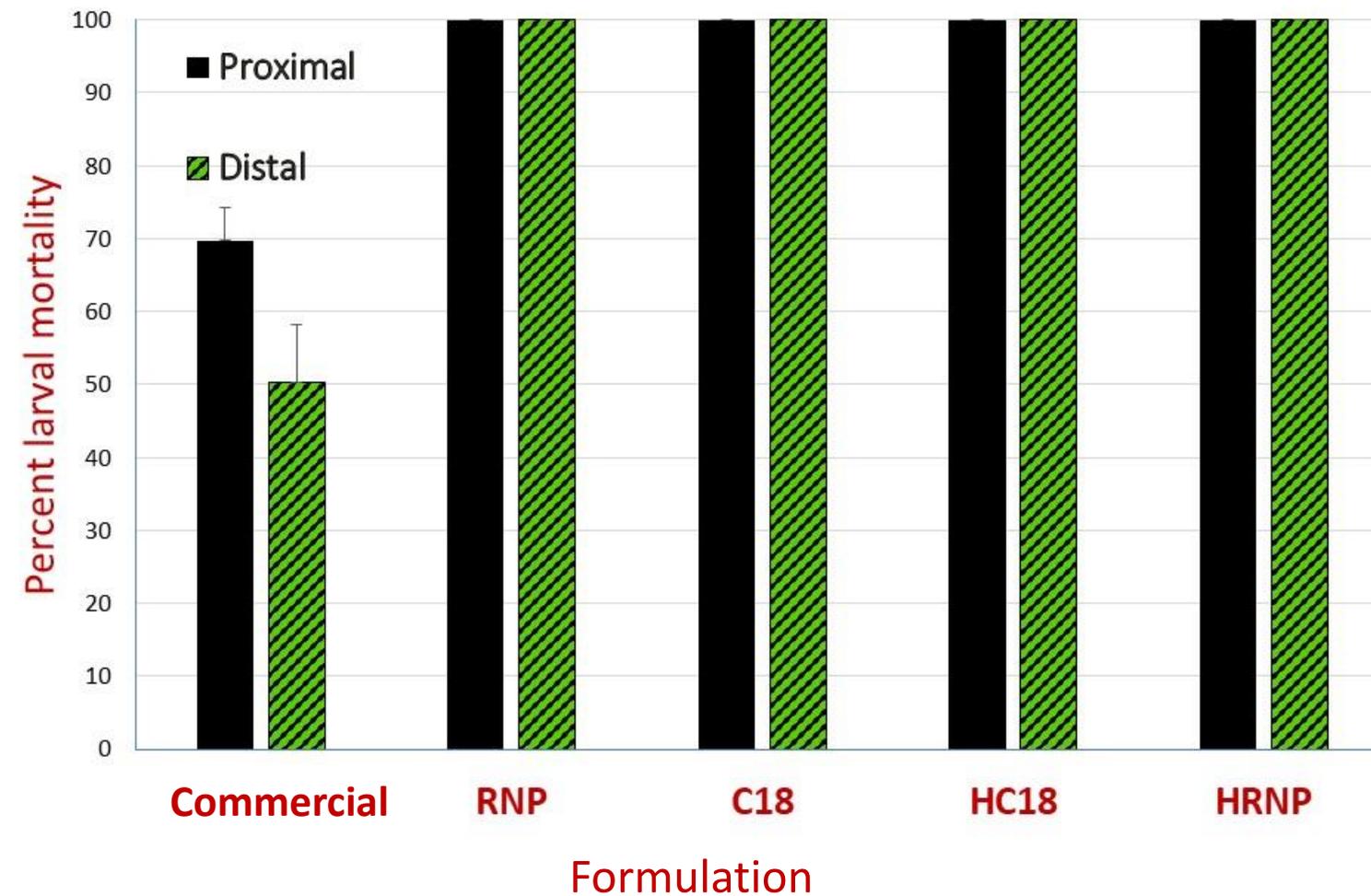


# Larval toxicity: cyromazine formulations following 16 weeks exposure to outdoor weathering

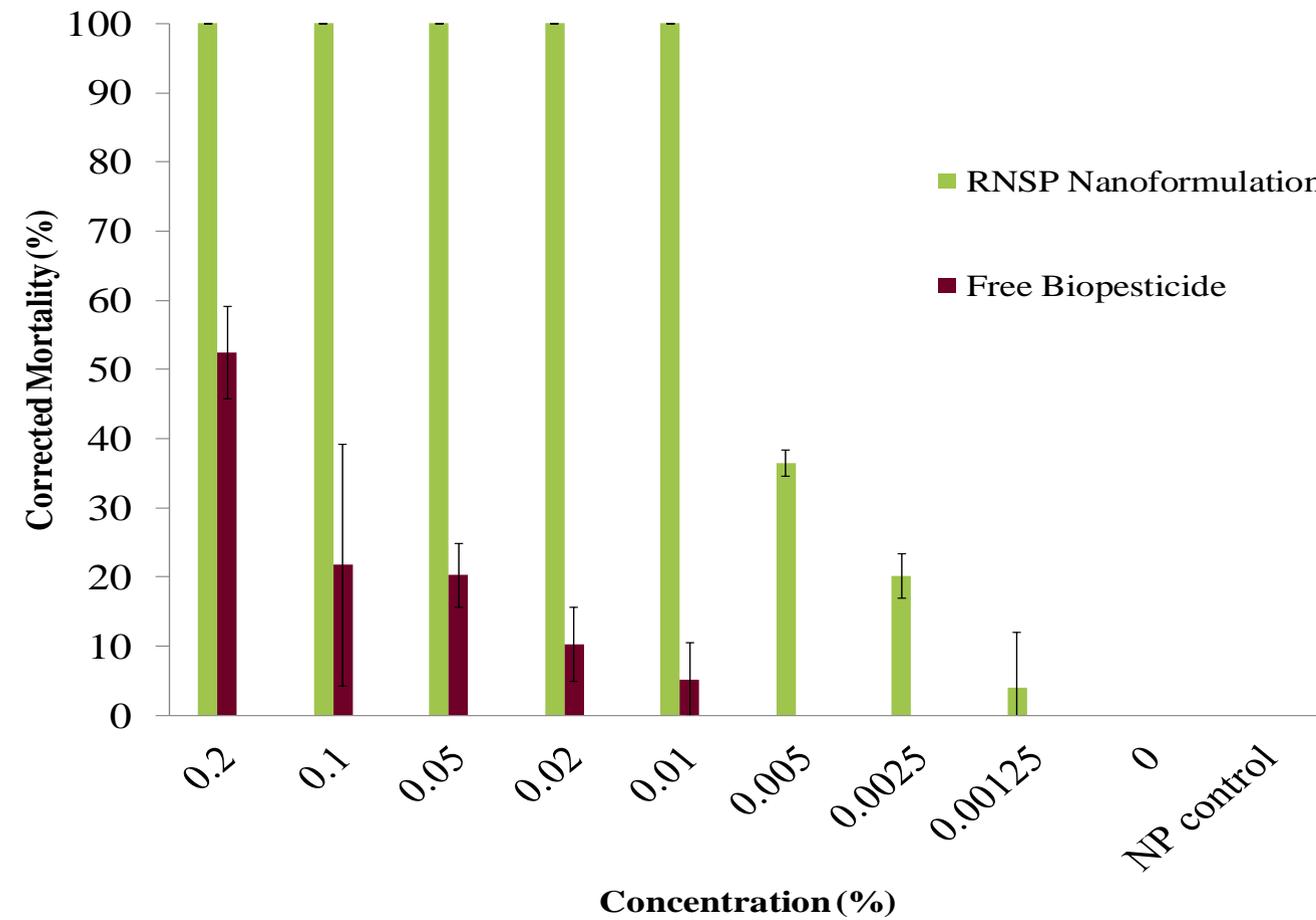


# Weathering effects on sheep run under paddock conditions

Larval kill with wool taken from sheep run in the paddock



# Encapsulation of plant extract (biopesticide) in nanoparticles



## Summary

- Increased longevity of effect
- Applicable to a range of chemical actives (hydrophobic and hydrophilic)
- Tunable/targeted design to suit purpose
- Design to reduce chance of tissue absorption/meat residues
- Potential to reduce selection for resistance
- Make less persistent chemicals feasible
- Amenable to application with existing equipment
  
- More sheep studies needed



## Acknowledgements

Prof Michael Yu, Australian Institute Bioengineering and  
Nanotechnology, (AIBN) UQ

Prof Neena Mitter, QAAFI, UQ

Dr Mona Moradi-Vargarah, QAAFI

Dr Lillian Mukandiwa, QAAFI

Geoff Brown, Dept Ag and Fisheries, Queensland

Dr Hao Song, AIBN

Dr Jun Zhang, AIBN



This publication is based on information presented at the Australian Wool Innovation Limited (AWI) Flystrike RD&E Technical Forum held on 10th August 2022. Some information in this publication has been contributed by one or more third parties and licenced to AWI, and AWI has not verified whether this information is correct. This publication should only be used as a general aid and is not a substitute for specific advice. To the extent permitted by law, we exclude all liability for loss or damage arising from the use of the information in this publication. Except to the extent permitted under Copyright Law no part of this publication may be reproduced by any process, electronic or otherwise without the specific written permission of AWI. Neither may information be stored electronically in any form whatsoever without such permission. AWI is grateful for its funding, which is primarily provided by Australian woolgrowers through a wool levy and by the Australian Government which provides a matching contribution for eligible R&D activities. © 2022 Australian Wool Innovation Limited. All rights reserved.