

OP-122 [Bee Health] Chemical Innovations in Varroa destructor Mite Control

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Beekeepers worldwide face unacceptable annual colony losses, largely due to the ectoparasitic mite *Varroa destructor*. This mite compromises individual bee health by vectoring viruses and disrupting physiology and also contributes significantly to colony winter losses. The emergence of varroacide resistance and limited efficacy of current treatments highlight the need for new control strategies that effectively target *Varroa* while minimizing harm to honey bees. Building on prior research assessing the impact of 26 potential miticides, we selected five promising candidates to evaluate their effects on honey bees and mites. Through a combination of laboratory and field experiments, we assessed survival of brood and diverse adult bee castes, and mite mortality. Queens generally exhibited greater tolerance to the test compounds than worker bees. Across all compounds and doses, mortality was highest in drones, followed by newly emerged workers, foragers, and nurses. This variation indicates that caste differences need to be taken into account when testing compounds for honey bee toxicity. Two pyrazole-based miticides exhibited relatively high toxicity across all age cohorts and castes, whereas the other three compounds showed little mortality at low doses no bees. Field trials of these two substances in nucleus hives demonstrated that they can effectively control *Varroa* without observable negative impacts on queens or adult bee populations. Combined with their previously established efficacy against *Varroa* in the lab, our findings suggest that these miticides could be valuable additions to integrated pest management (IPM) strategies to control *Varroa* in apiculture.

Chemical Innovations in *Varroa destructor* Mite Control

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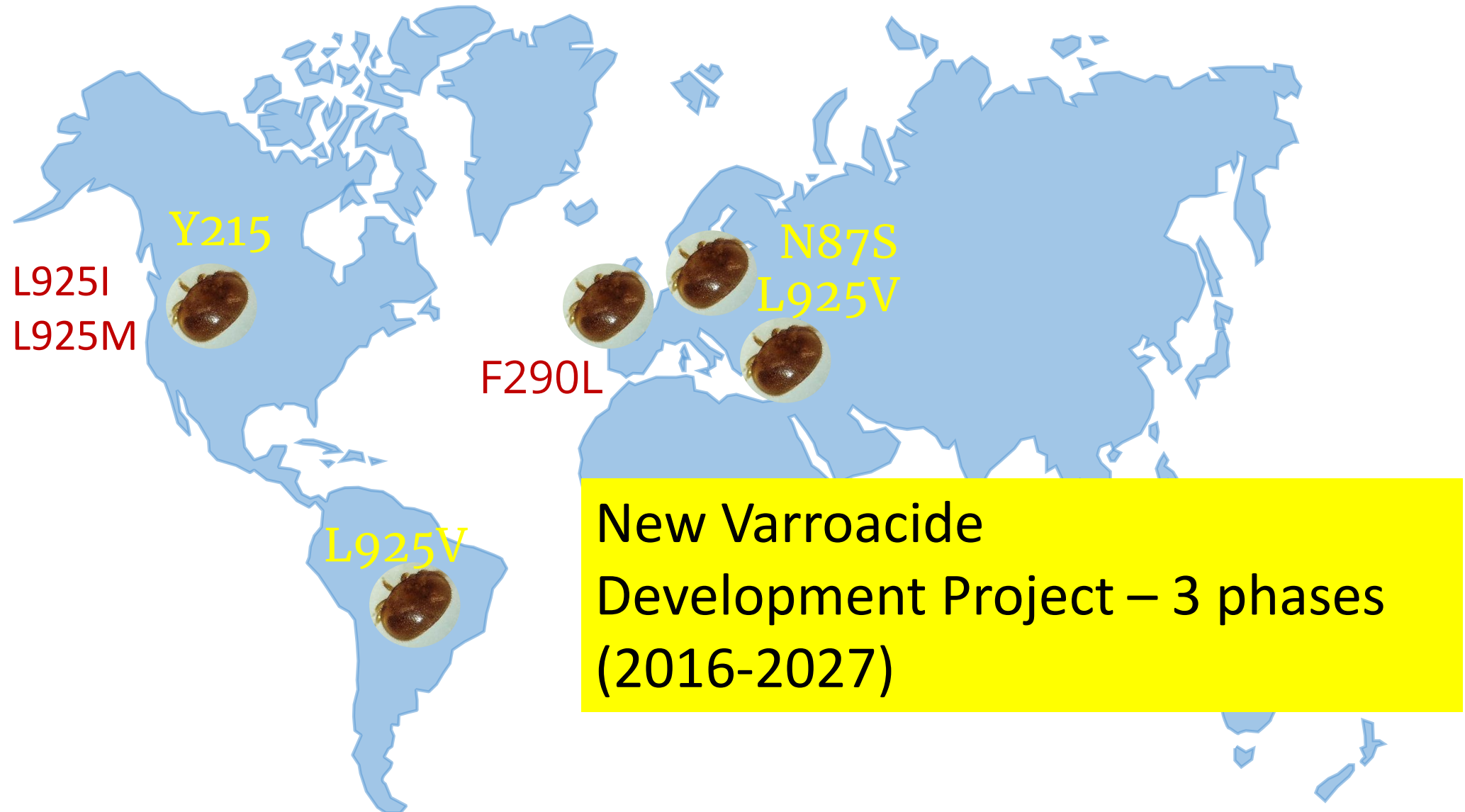


Varroa resistance to miticides



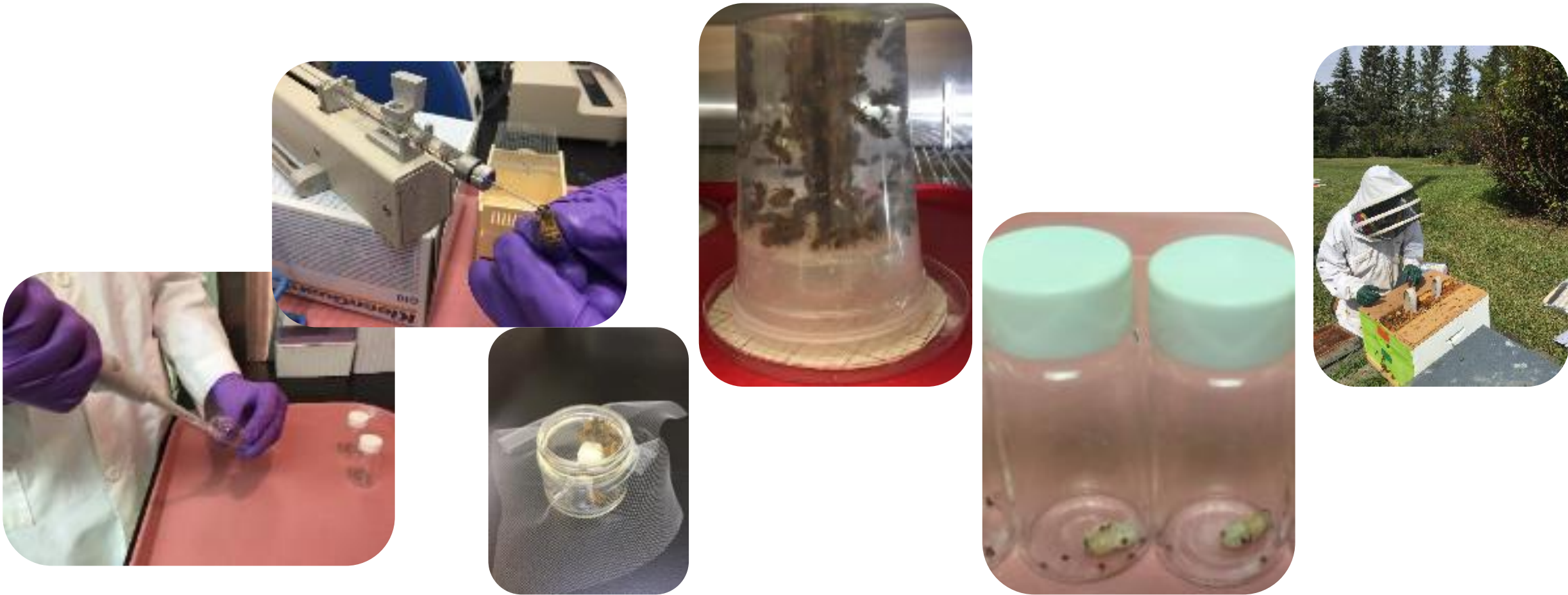
(Millán-Leiva et al. 2021, Hernández-Rodríguez et al. 2022, Marsky et al. 2024, Rinkevich et al. 2023, Vlogiannitis et al. 2021, Mitton et al. 2021)

Varroa resistance to miticides



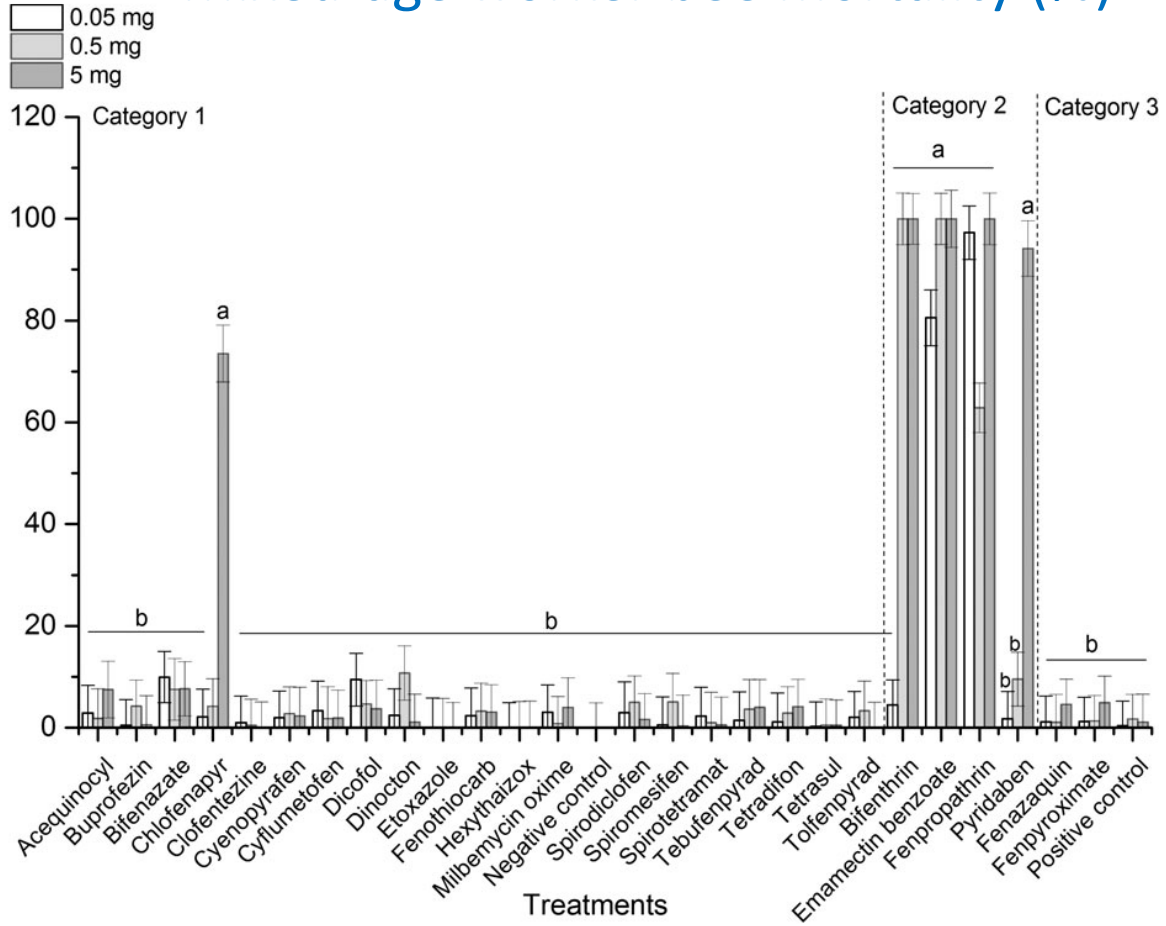
Varroacides development project Phase 1 (2016-2020)

Lethal toxicity of >25 active ingredients to mites and bees

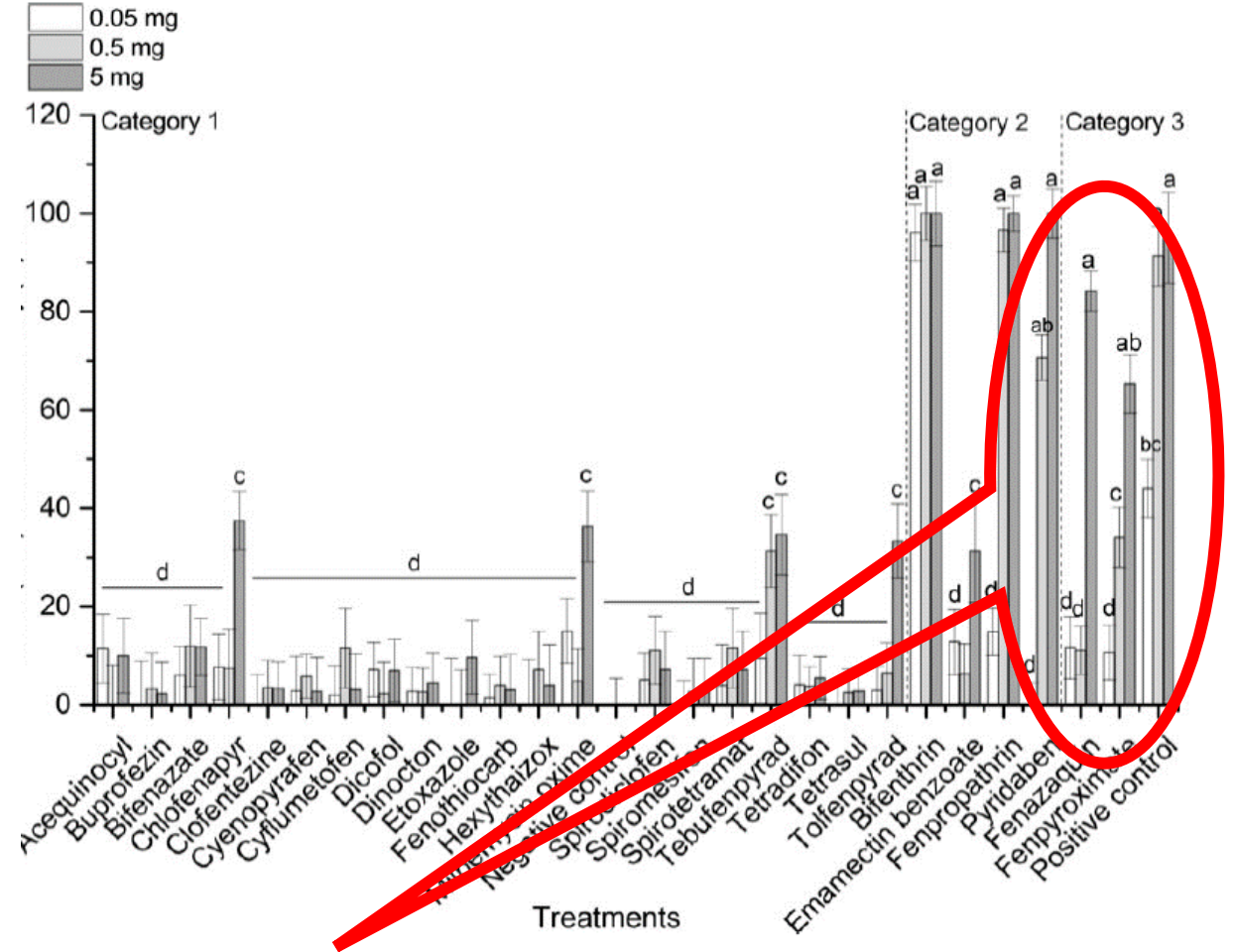


Varroacides development project- Phase 1

Mixed-age worker bee mortality (%)



Varroa mortality (%)



Higher Varroa mite mortality

(Bahreini et al. 2020, 2022)

Varroacides development project

Phase 2 (2022-2024)

Lethal toxicity of 5 active ingredients to mites and different honey bee castes



Mites



Queens



Drones



Newly-emerged workers



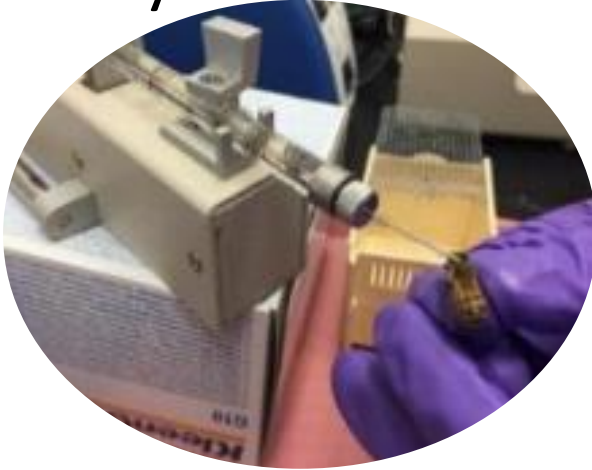
Nurses



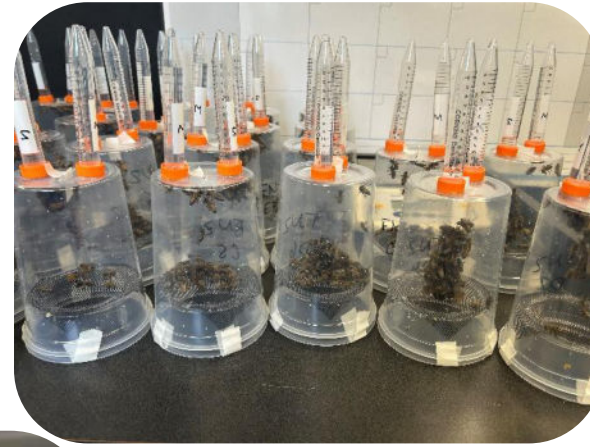
Foragers

Lab toxicological studies – Phase 2

Topical toxicity



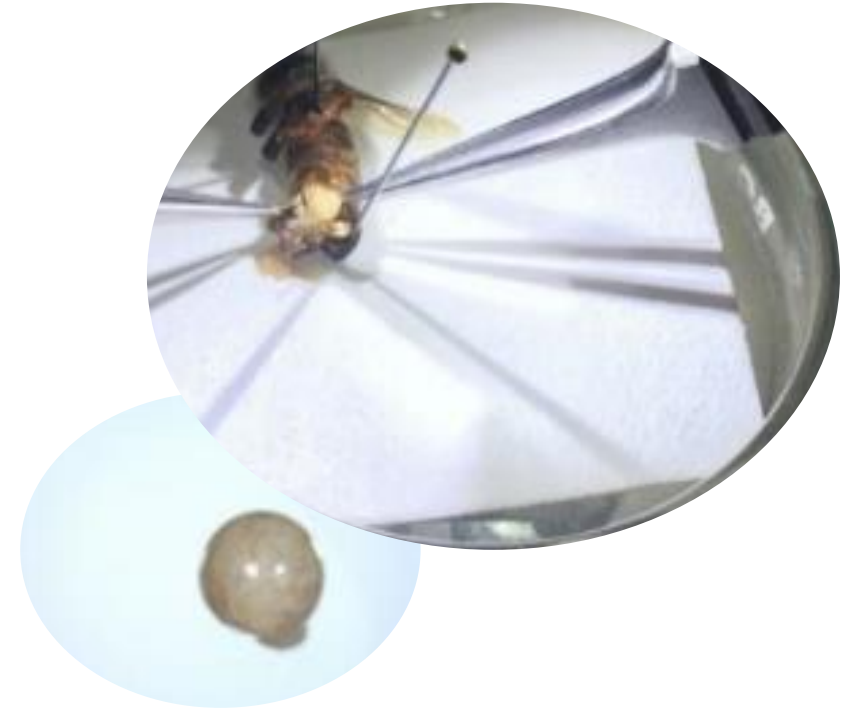
Sublethal effects



Contact toxicity
Oral toxicity



Lethal effects on mite + bee



Queen/ sperm viability

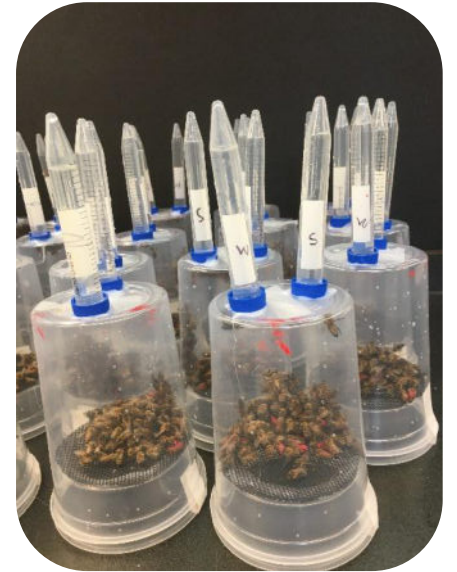
Lab assay on different castes and age cohorts



Queen

Drone

Five compounds
Reference control (Dimethoate)
Positive control (Amitraz)
Negative control
6 replicates



Worker:

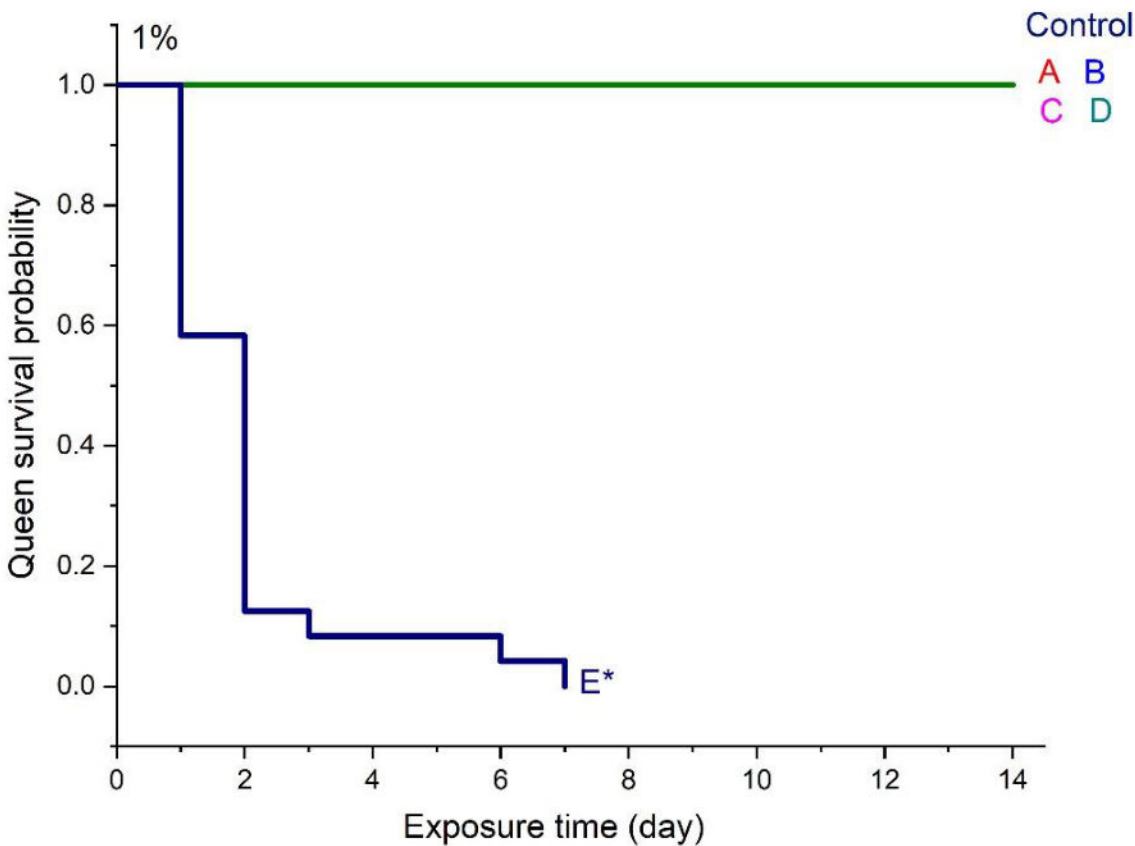
Newly-emerged (day 1)

Nurse (day 7)

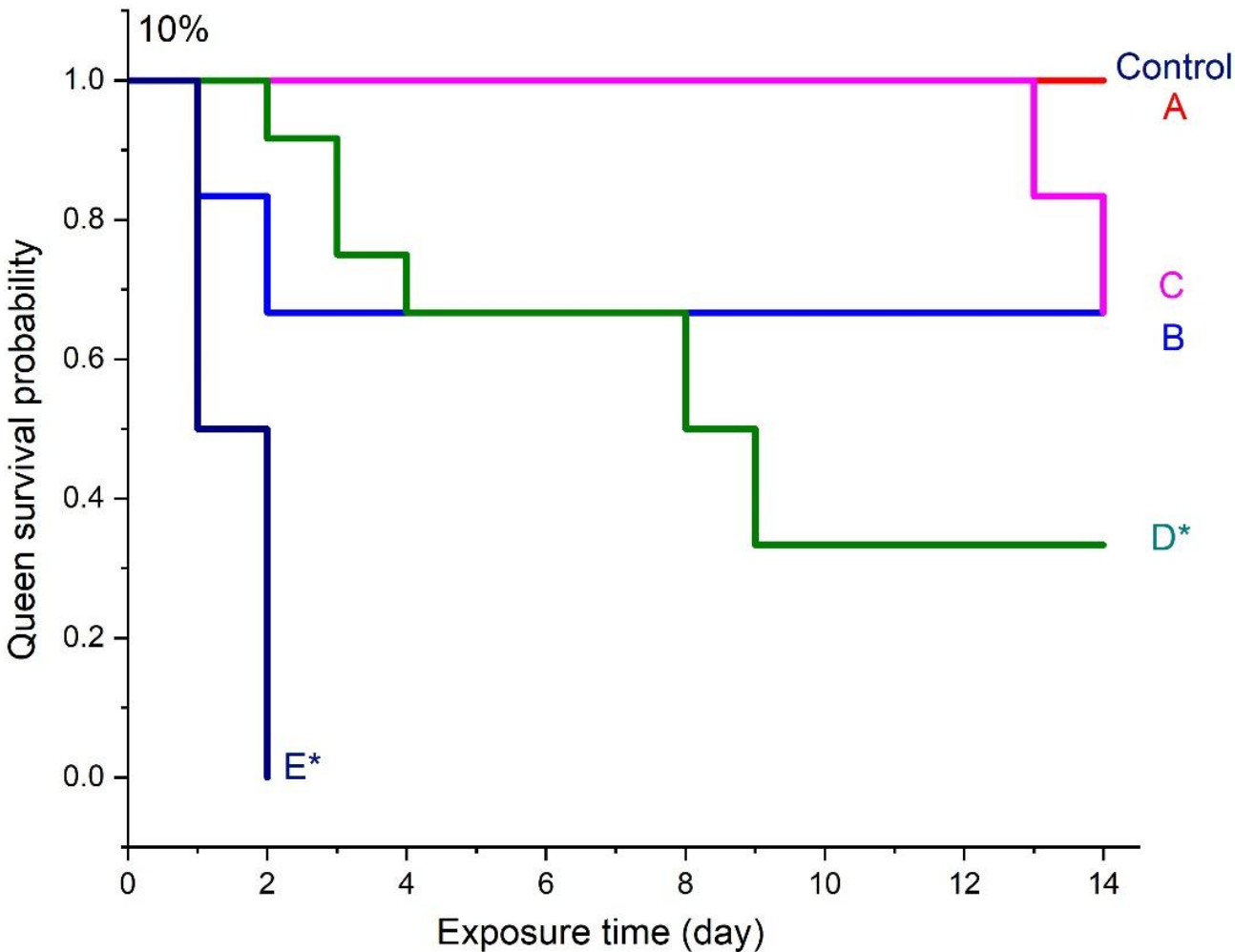
Forager (day 21)



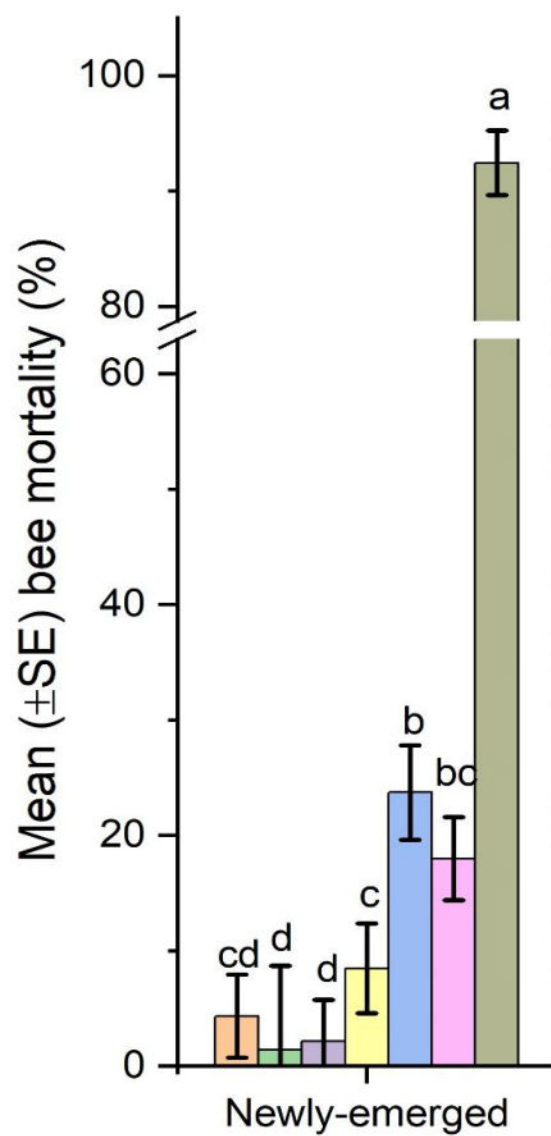
Queen viability



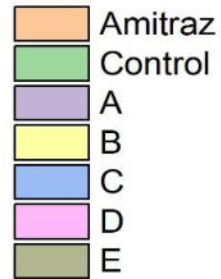
	χ^2	df	p
Wilcoxon	43.299	5	<.0001



	χ^2	df	p
Wilcoxon	35.0307	5	<.0001



Age cohorts - Castes



Cumulative toxicity of compounds

Newly-emerged

F= 65.3
df=6, 143
 $P < 0.0001$

Nurse

F= 7.37
df=6, 140
 $P < 0.0001$

Forager

F= 13.25
df=6, 143
 $P < 0.0001$

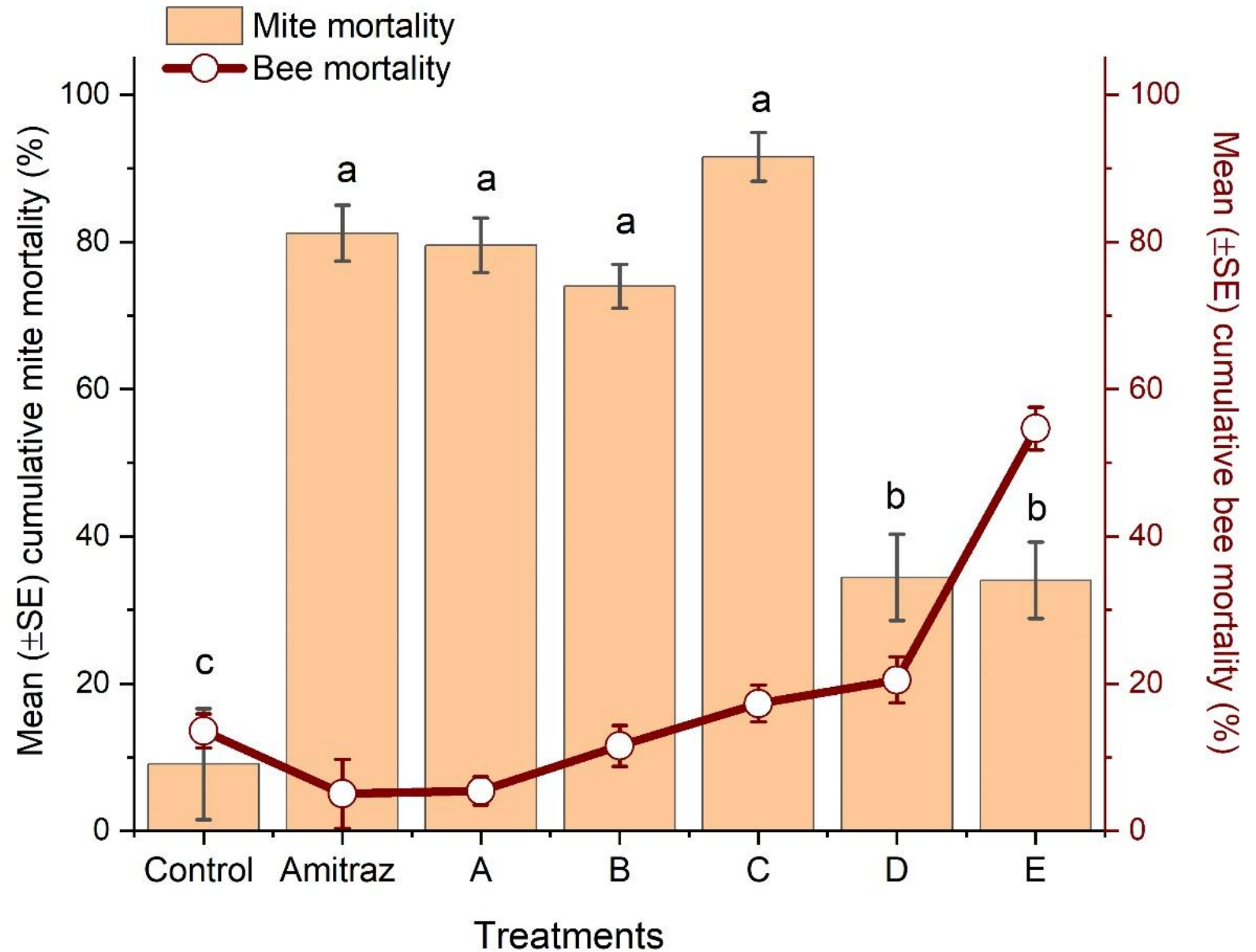
Drone

F= 10.21
df=6, 142
 $P < 0.0001$

Cumulative toxicity of compounds to Varroa and mixed-age bees (3 days)



Apiarium cage bioassay



Varroacides development project

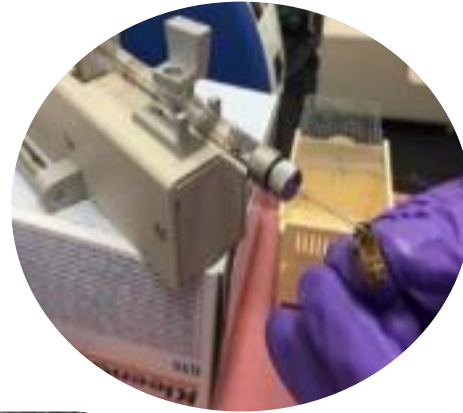
Phase 3 (2025-2027)

Evaluation of 2
compounds

Topical toxicity



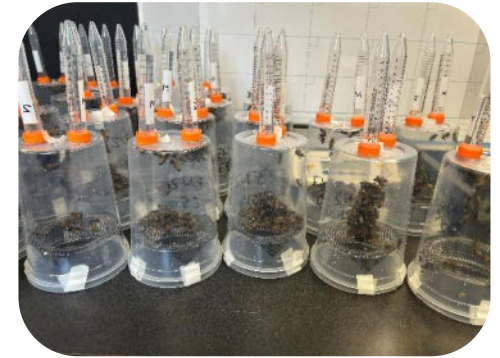
Larvae viability



Field test



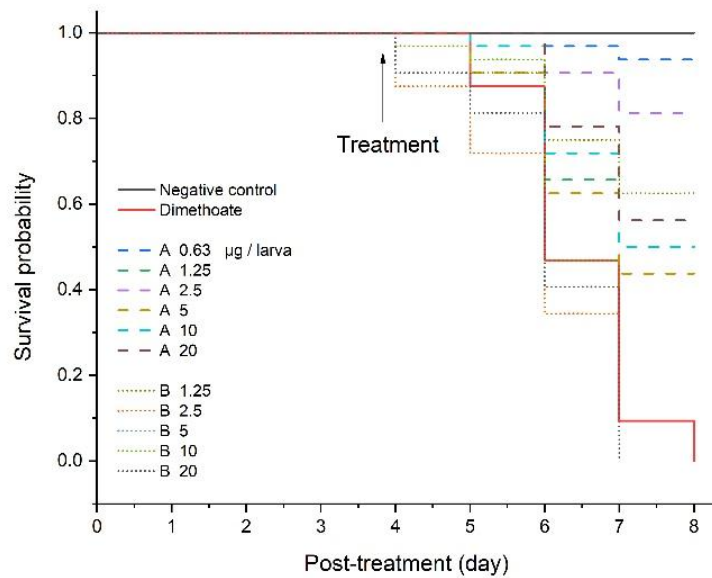
Lethal effects on mite + bee



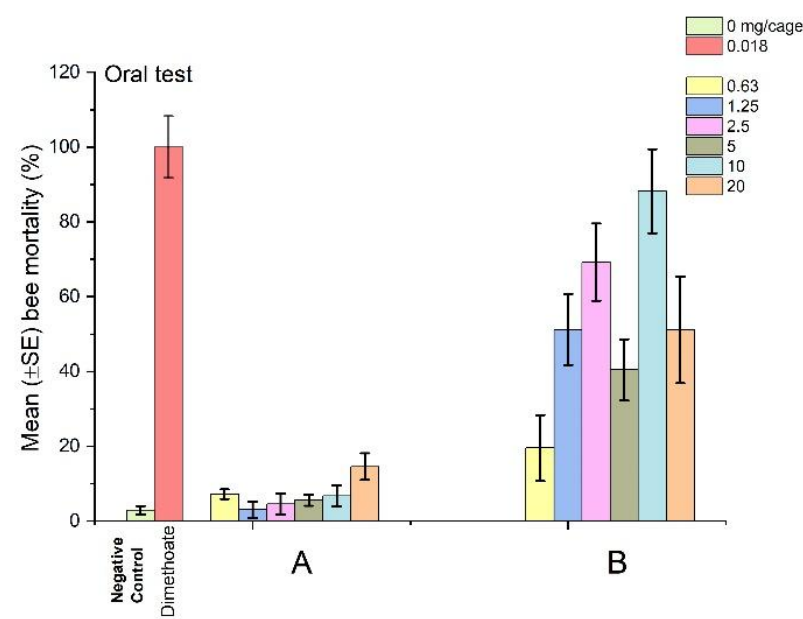
Contact toxicity
Oral toxicity

Toxicity of compounds to bees

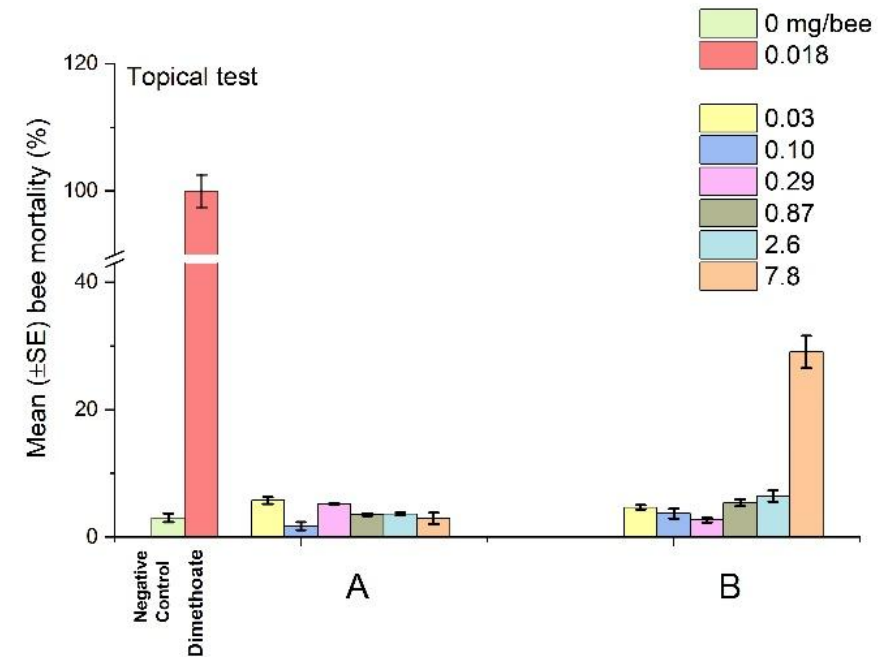
Larval acute testing (OECD 237)



Adult acute oral testing (OECD 213)



Adult acute topical testing (OECD 214)



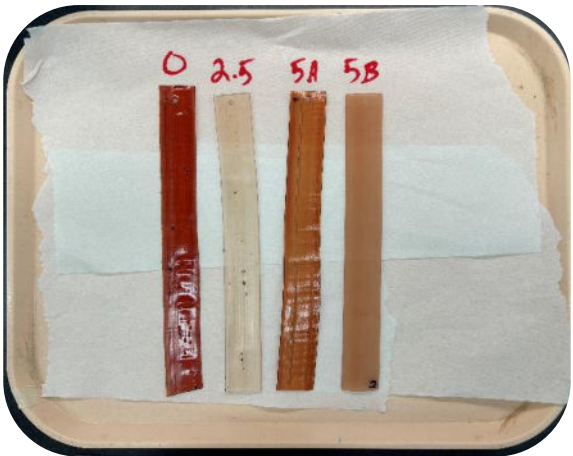
Organization for Economic Co-operation and Development (OECD)

Field assessments

Organic applicators



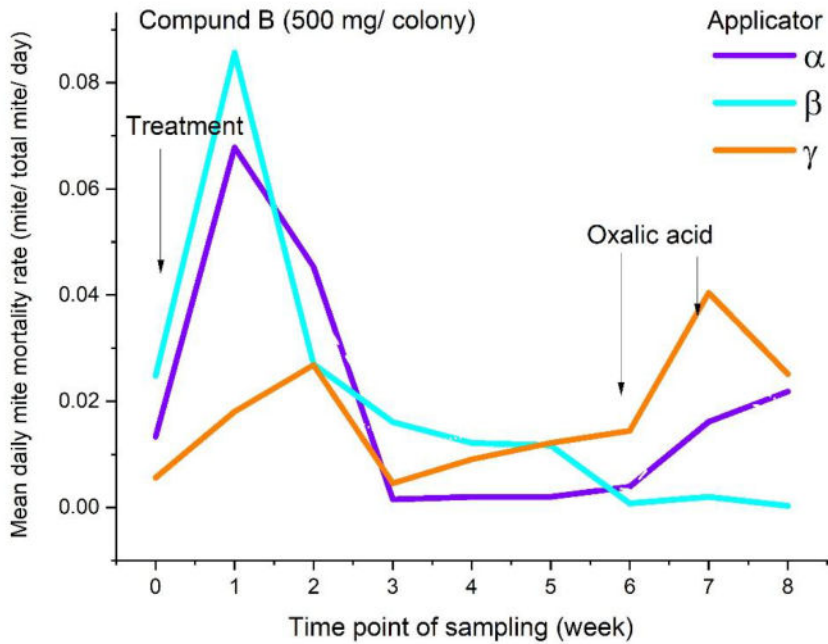
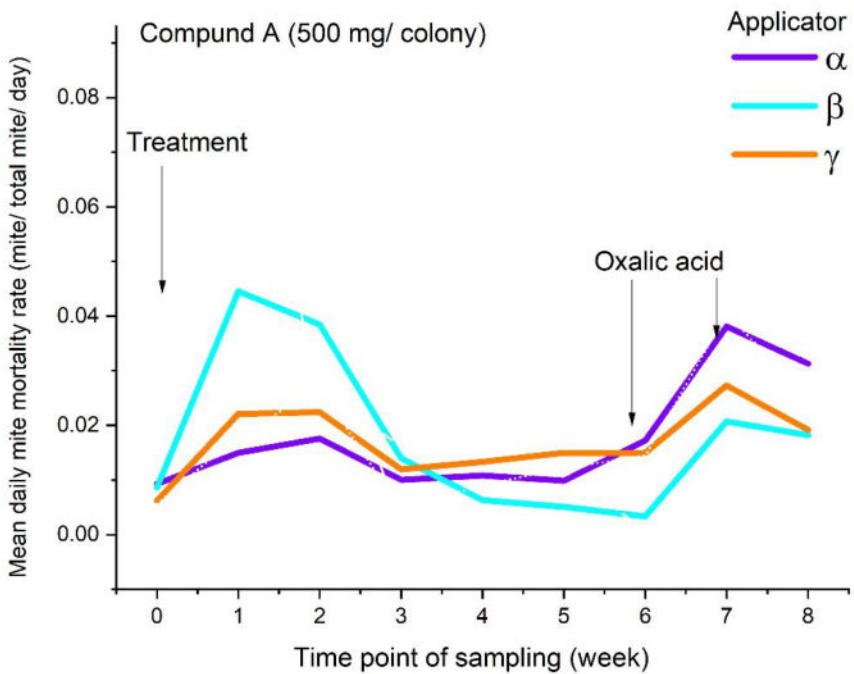
Plastic applicators



Strip prototypes
(Vita Bee Health)



Daily mite mortality rate



Conclusion



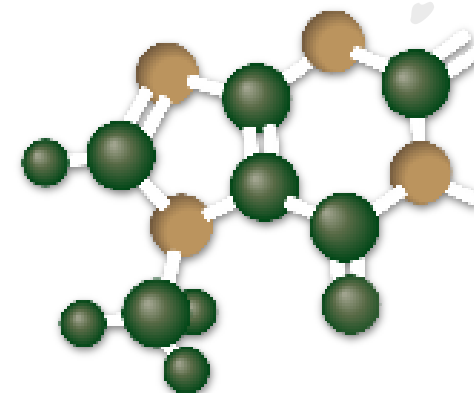
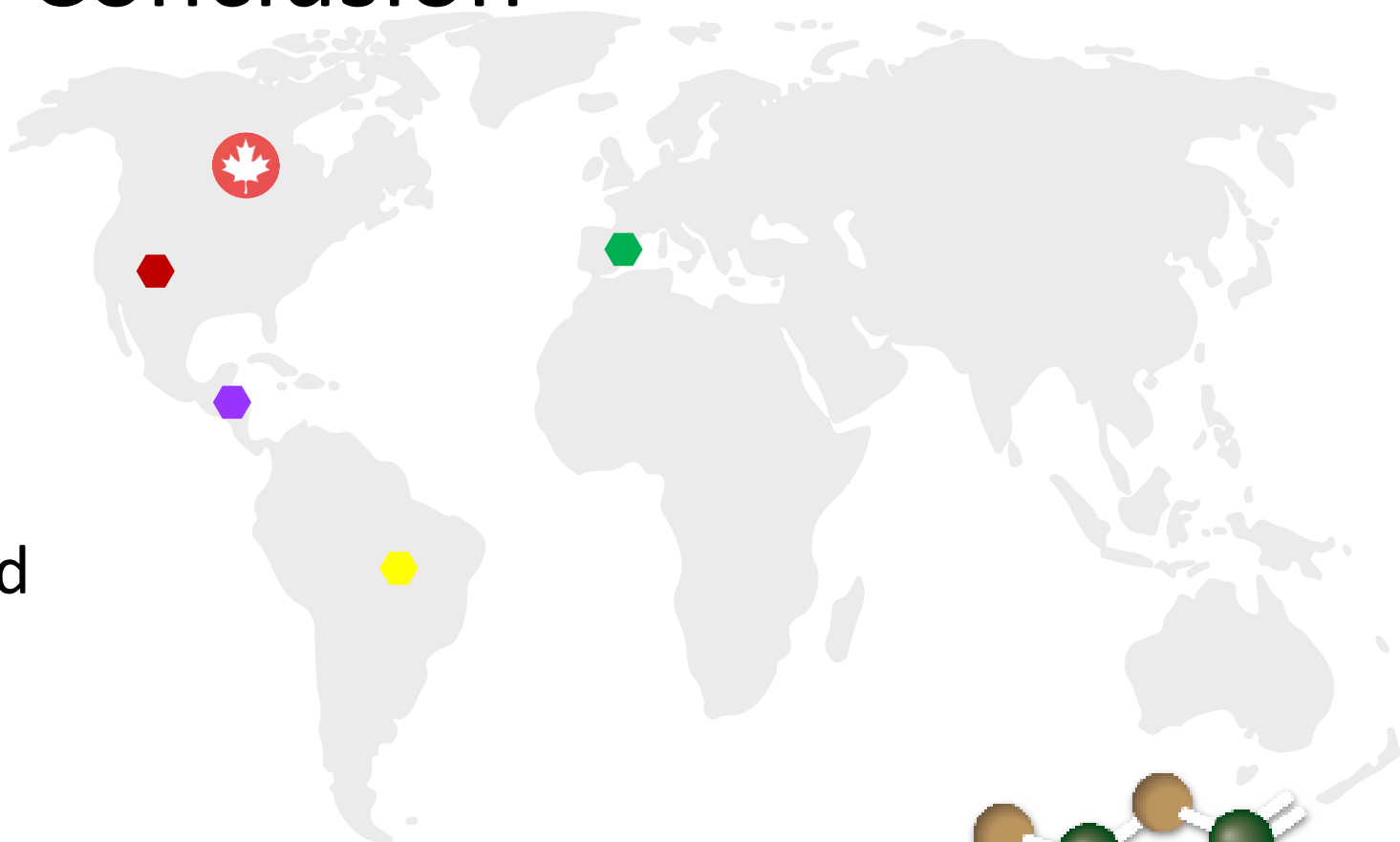
Compounds A and B:
lethal to Varroa
safe for bees



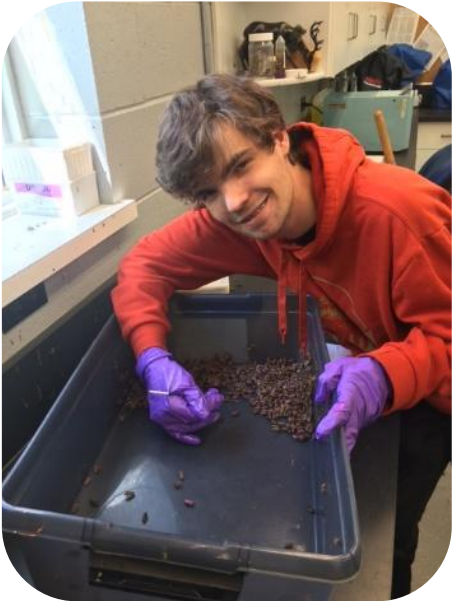
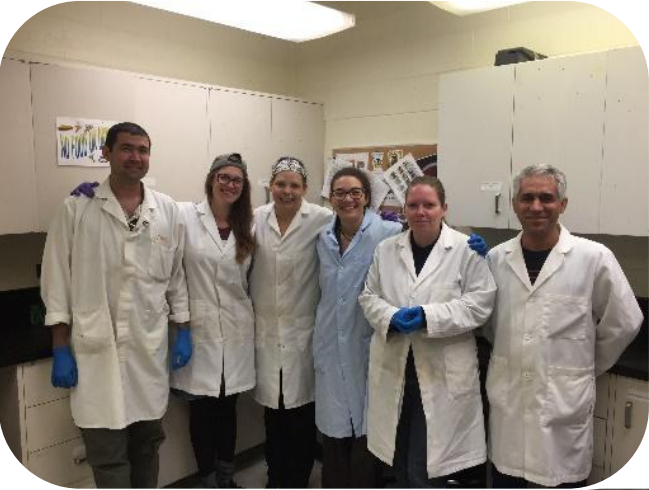
Optimizing dosage,
treatment timing, and
delivery methods



Potential
international
collaboration



Acknowledgments



Acknowledgments



Crop Diversification Centre North (CDCN)

