

# The effects of chlorpyrifos-based sprays on honey bees in Central Otago



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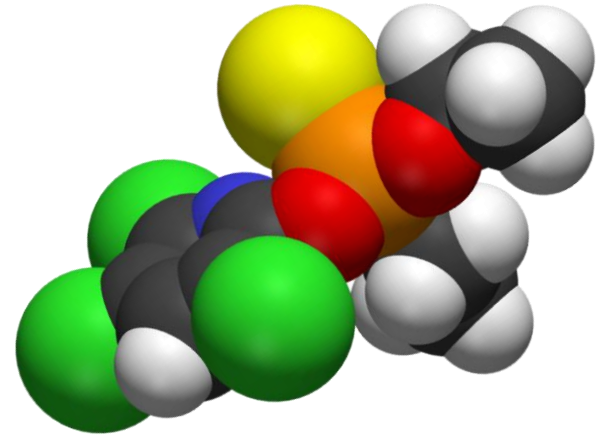
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# What is chlorpyrifos?

Organophosphate

Old-generation pesticide

Neurotoxic



Used internationally to control  
pests on agricultural crops

Motor and cognitive effects of  
chlorpyrifos are known to  
impair foraging efficiency

Growing concern over use





# High use in New Zealand





Chlorpyrifos found in 17% of apiaries  
12% of all hives had bees with chlorpyrifos  
Concentrations 35 - 286 pg per bee  
**Well below LD<sub>50</sub> (~100 ng per bee)  
but still of concern**



**Do randomly-collected Central Otago honey bees  
have chlorpyrifos in their bodies?**



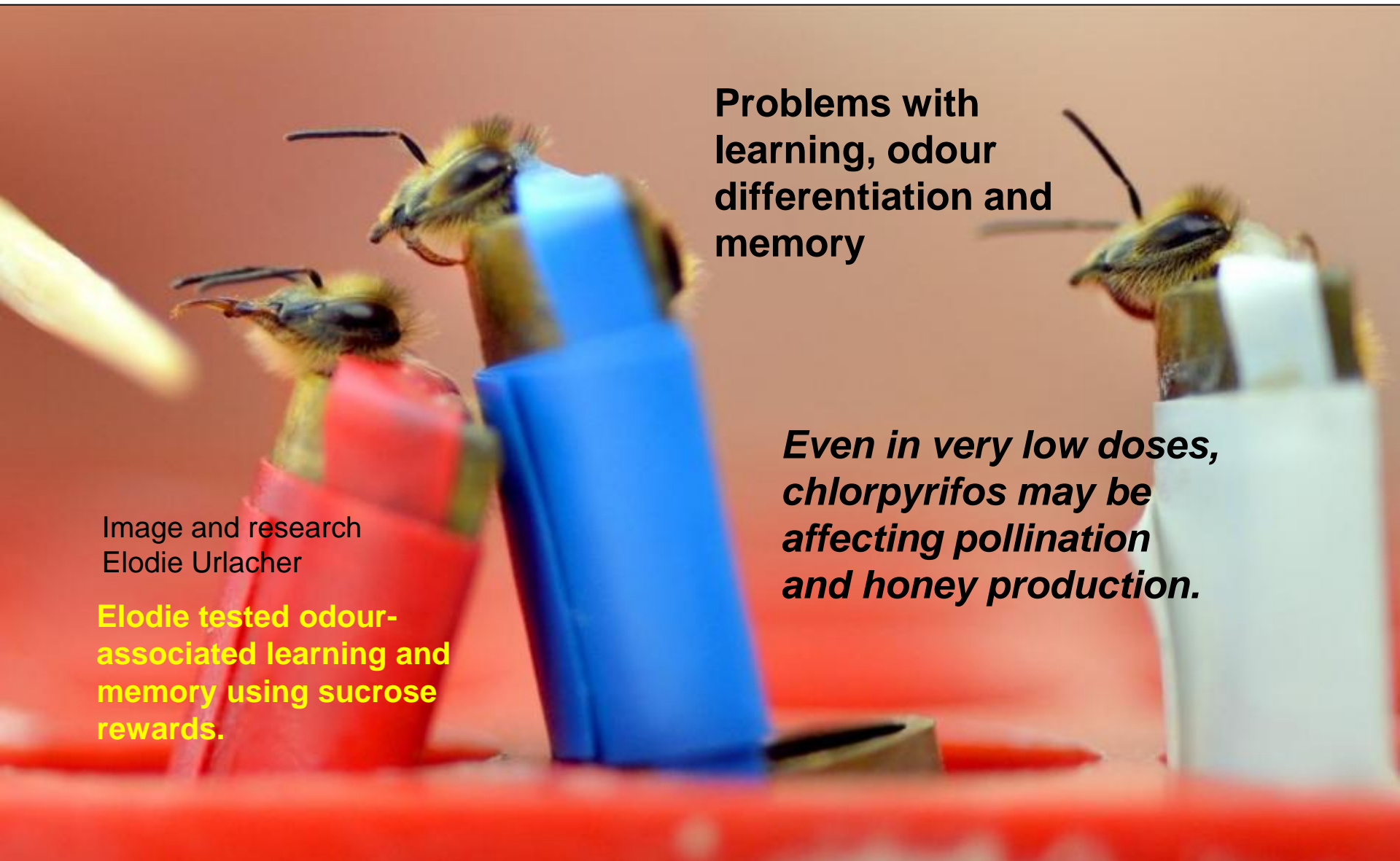
In the lab, foragers were fed sucrose syrup spiked with chlorpyrifos in field-matched concentrations

Problems with  
learning, odour  
differentiation and  
memory

*Even in very low doses,  
chlorpyrifos may be  
affecting pollination  
and honey production.*

Image and research  
Elodie Urlacher

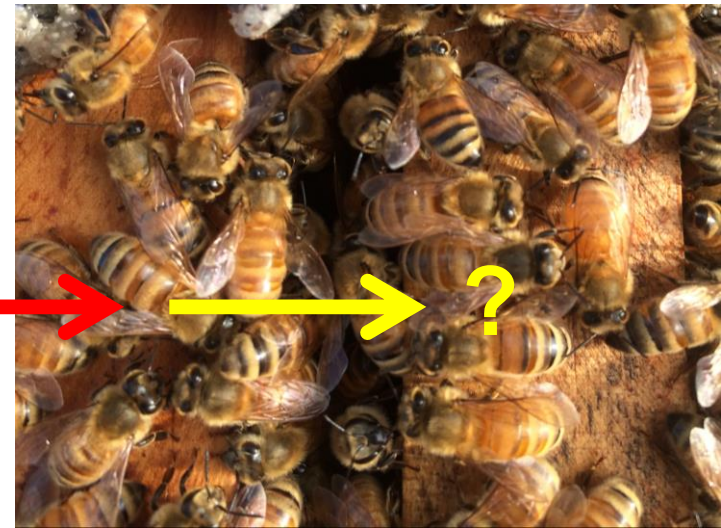
**Elodie tested odour-  
associated learning and  
memory using sucrose  
rewards.**



# Core questions

## With exposure to chlorpyrifos sprays

- Does chlorpyrifos accumulate in bees?
- Does the timing of hive introduction affect chlorpyrifos accumulation?
- What is the fate of chlorpyrifos in the colony?
- What is the effect on the colony?



# Why study chlorpyrifos in Central Otago?

New Zealand locally relevant information was needed

Agricultural diversity

Changing landscape use

High chlorpyrifos use







Preparing the  
study site





Treated site in Ida Valley



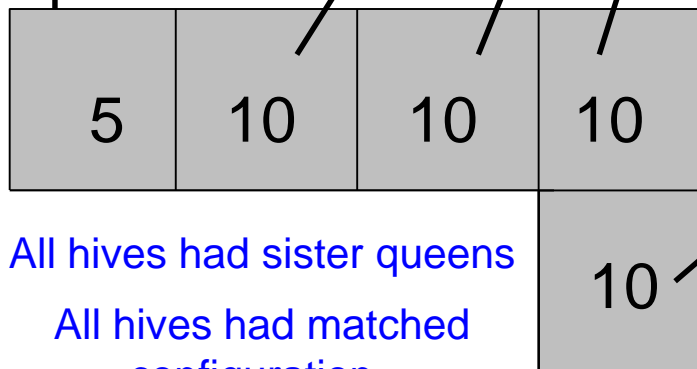
Introduced two weeks before spraying



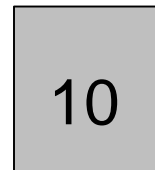
Untreated site 10km from Ida Valley



Testing the effect of moving hives



All hives had sister queens  
All hives had matched configuration



**CONTROL SITE** 14km from Ida Valley site  
Set up two months before experiment

# Experimental set-up

# Field sampling

Ida Valley chlorpyrifos sampling schedule, Summer 2017

Day	Colour key	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	48	57
Date		Sun Jan 8	Mon Jan 9	Tue Jan 10	Wed Jan 11	Thur Jan 12	Fri Jan 13	Sat Jan 14	Sun Jan 15	Mon Jan 16	Tue Jan 17	Wed Jan 18	Thur Jan 19	Fri Jan 20	Sat Jan 21	Sun Jan 22	Mon Jan 23	Tue Jan 24	Wed Jan 25	Thur Jan 26	Fri Jan 27	Sat Jan 28	Sun Jan 29	Mon Jan 30	Tue Jan 31	Wed Feb 1	Thur Feb 2	Fri Feb 3	Sat Feb 4	Sun Feb 5	Sun Feb 26	Mon Mar 6
Hours post spraying		0	24	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408	432	456	480	504	528	552	576	600	624	648	672		
K	●	already on site	●	●	●		●		●		●			●	→		●			●			●					●			●	●
Red	●			Reds introduced	●	●	●		●		●		●		←	●			●			●			●				←	●	●	●
Green	●				Greens introduced		●	●	●		●		●		●		●				●			●			●				●	●
Blue	●						Blues introduced		●	●	●		●		●		●			●			●			●			●		●	●



*Foragers*

*Nurse Bees*

*Pupae*

*Pollen*

*Emergent adults*

*Drones*

*Queens*



# Exposure routes

Respiration

Contact

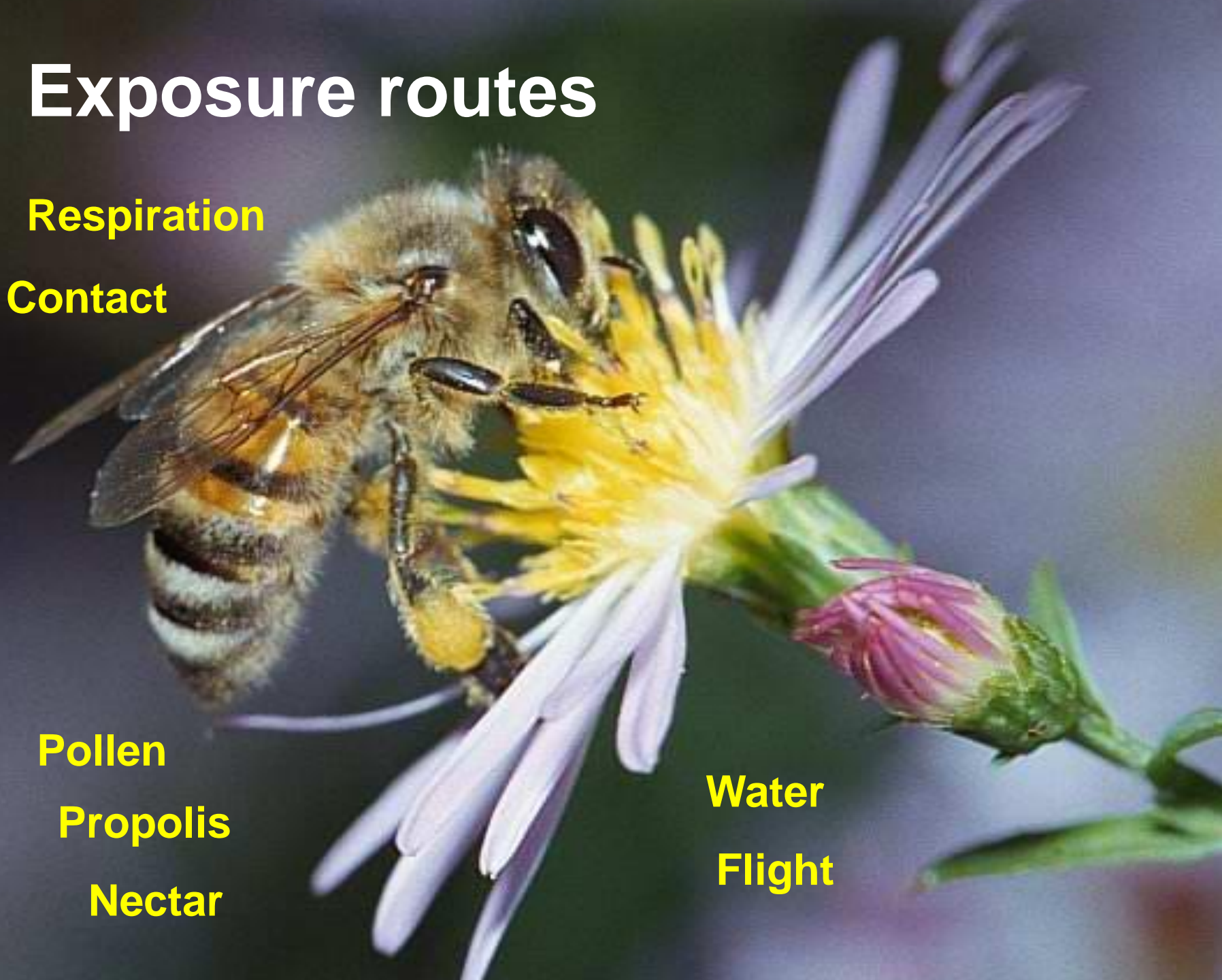
Pollen

Propolis

Nectar

Water

Flight



# Results of field study

Foragers had a maximum chlorpyrifos level (689 pg/bee) well above maximum level found in the random Central Otago survey (286 pg/bee).

Maximum chlorpyrifos levels found (pg/bee)

Queens > Nurse bees > Foragers > Larvae > Emergent adults > Drones

804

99

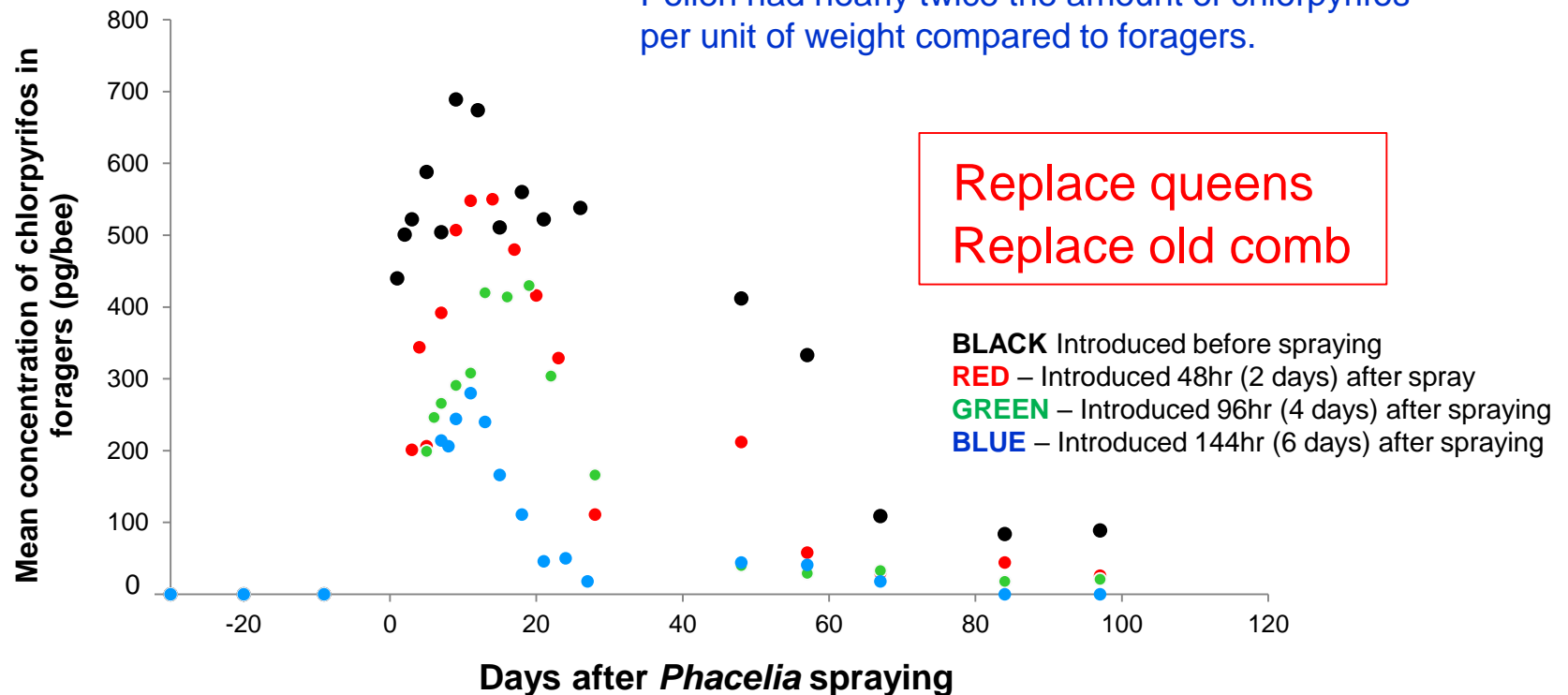
689

412

394

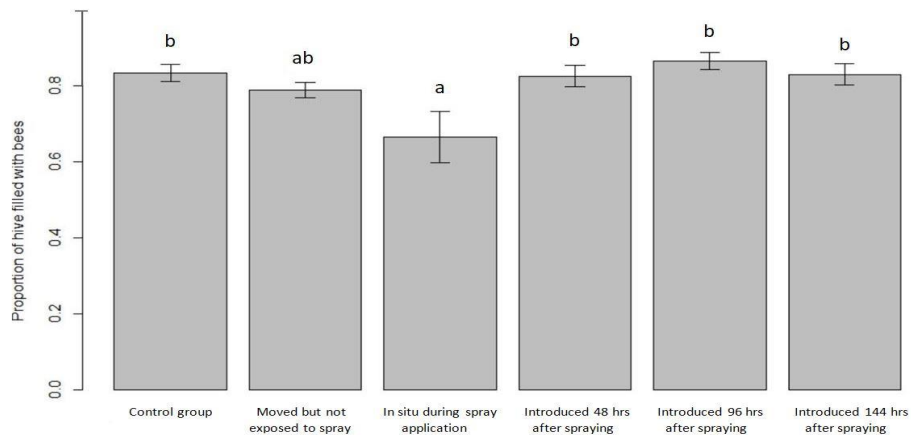
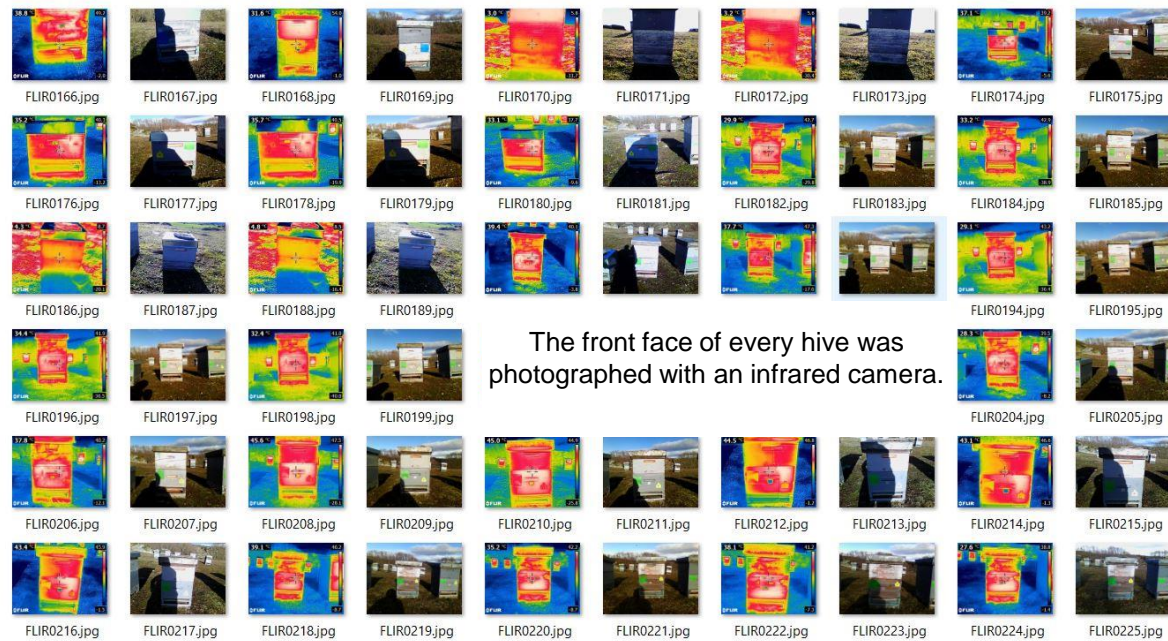
350

Pollen had nearly twice the amount of chlorpyrifos per unit of weight compared to foragers.



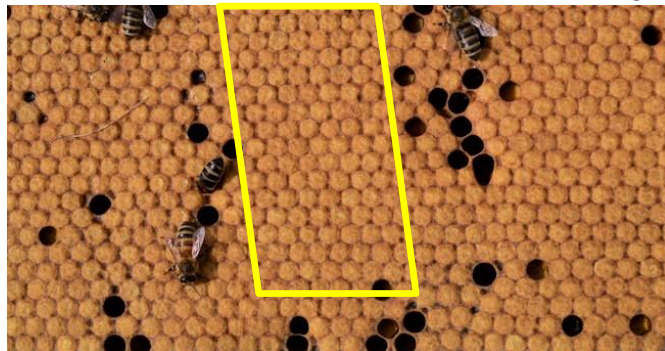
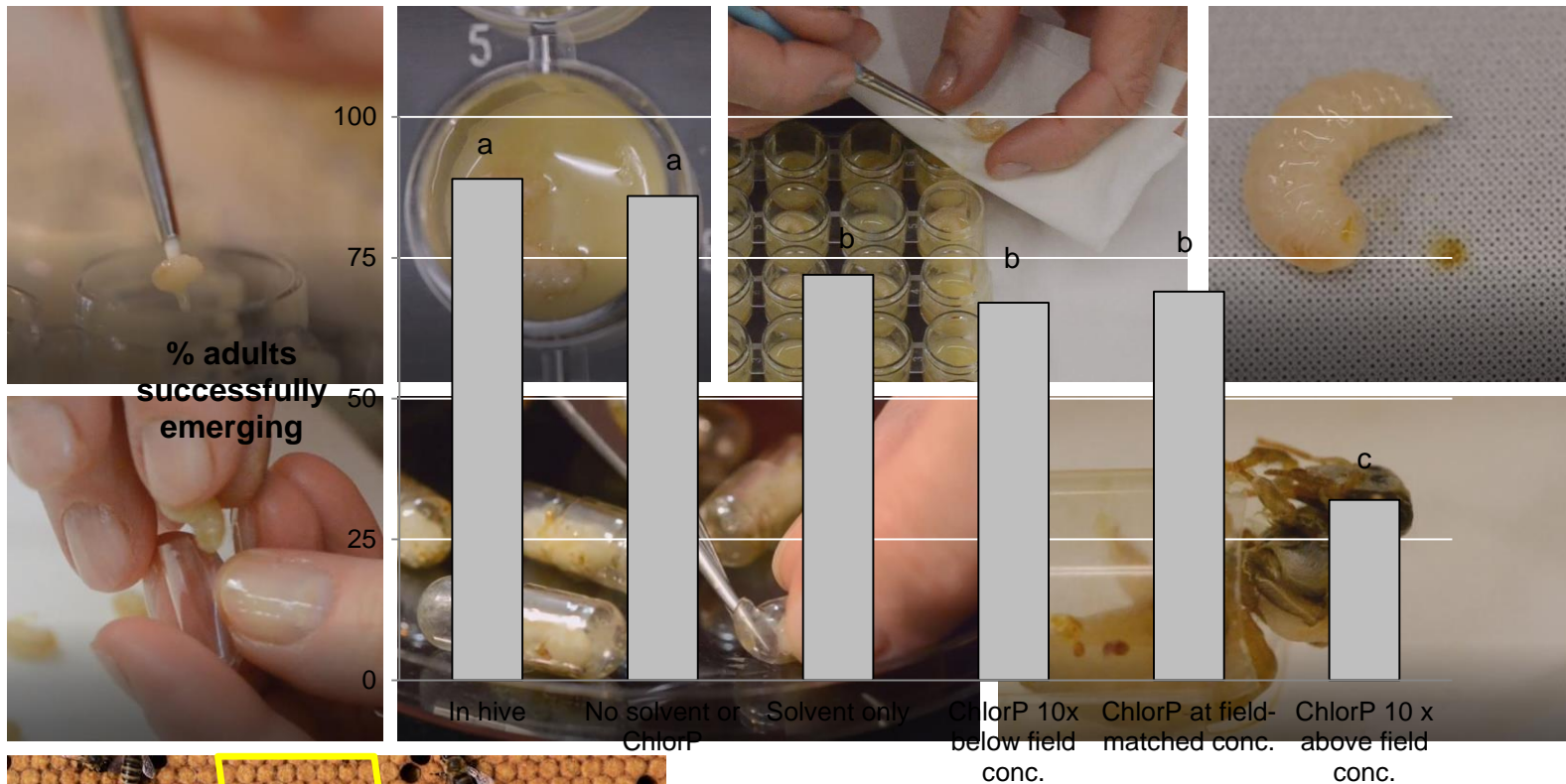


# Infrared imaging to assess colony cluster size in winter



- Check hives
- Consider infrared monitoring

# Culturing bees in the lab



2 replicates of each treatment

48 larvae per treatment

Recent research overseas suggests nutritional supplements may reduce loss





## **The chemical cocktail effect**



## Mitigation – how can we reduce the effects of pesticides?

- Replace queens frequently
- Replace older comb
- Consider using infrared monitoring
- Consider using remote hive monitoring
- Wherever possible feed honey not sugar
- Avoid varroa treatments in peak spray season - again, talk to farmers - remember the cocktail effect
- Consider drift – involve agro-chem contractors – map your land use
- Supplements containing micro-nutrients improve immunity
- Dialogue – community discussion – liaise with research groups



**Thank you for listening**

[www.sueheathscience.com](http://www.sueheathscience.com)



My supervisors Alison Mercer, Kim Hageman and Mark Lokman

Beekeepers of Central Otago

Paterson and Small families, Ida Valley

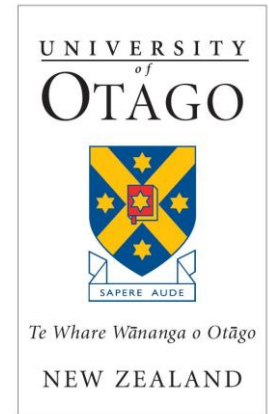
Reece Adamson, Wildpure Honey, Earnsclough

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