

- 6 Research Scientists
- 1 Support Scientist
- 2 post-doctoral researchers
- 5 Permanent technicians
- Graduate, undergraduate students

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#### USDA Bee Biology and Systematics Laboratory - Utah Agricultural ...

#### uaes.usu.edu > Farms and Facilities 🔻

USDA Bee Biology and Systematics Laboratory Location: 5310 Old Main Hill | Logan, UT 84322-5310. Tel: (435) 797-2524. Visit the **Logan Bee Lab** Website.

#### Pollinating Insect-biology, Management, Systematics Research ...

https://www.ars.usda.gov/.../logan.../pollinating-insect-biology-management-systemati... ▼ USDA-ARS-PWA Pollinating Insect-Biol., Mgmt. ... The mission of the Pollinating Insect-Biology, Management, Systematics Research unit is the development of non-Apis bees and enhancement of the role of native species in the pollination of annual, perennial, greenhouse, and nursery ...

Pollinating Insects - Biology, Management and ... - USDA ARS https://www.ars.usda.gov/pacific-west-area/logan-ut/pollinating-insect.../main/ •

Aug 12, 2016 - You wonder, "Are they bees? They don't exactly look like bees to me?" Another time, perhaps you are in your garden or out on your ranch, you ...





### Pathology lab

- Effects of adjuvants on ALCB health
- "Legless" ALCB adults
- Chalkbrood control



Dr. Diana Cox-Foster Email: Diana.Cox-Foster@ars.usda.gov



#### Adjuvants and ALCB health

H <sub>3</sub> C	$CH_{3} \qquad CH_{3} \qquad C$	р →
Table 1	(C <sub>3</sub> ⊓ <sub>6</sub> O)	
One organosilicon surfactant – many use	s." Ŕ	
Product	Use	% CAS
		27306-78-1
Silwet L-77	Crop protection adjuvant	60–100
CoatOSil 77, Xiameter OFX-0077 Fluids	Agriculture, coatings, textiles	70–90
Aquapy EW165 12/x1 Bot GB	Insecticide	2.5–25
CMR Can-Hance	Spray adjuvant	12
Paper and Paperboard Defoamer	Paper making	<10
Excel Wetting Agent	Plant protection	5–10
Zyglo Aqueous Developer ZP-5B	Fluorescent penetrant	5–10
Hortrange Calcium	Fertilizer	<5
Marson Smoothie II	Paint additive	1–5
Saltidin Lotion O/W 10%	Insect repellant	3
3M ESPE Imprint 3 Penta Heavy Body	Dental impression, implant	<2
PEG-8 Methyl ether dimethicone	Hair/skin conditioner, cosmetic	<1
RS Floor Polish Mat	Paint/stain	<1

<sup>a</sup> All products contain poly(oxy-1,2-ethanediyl), α-methyl-ω-[3-[1,3,3,3-tetramethyl-1-[(trimethylsilyl)oxy]disiloxanyl]propoxy]-, CAS 27306-78-1 (methoxy-capped TSS).

- Adjuvants like organosilicones are widely used, both in tank mixing in agriculture, industrial uses, and cosmetics
- See increased use
- Experiments to ask toxicity to adult bees and to larvae

Chen J, Fine JD, Mullin CA. 2018. Are organosilicon surfactants safe for bees or humans? Sci Total Environ. 612:415-421.



OSSs differ in toxicity to bees, with increased use of most toxic OSS in CA since 2000

> Chen J, Fine JD, Mullin CA. 2018. Are organosilicon surfactants safe for bees or humans? Sci Total Environ. 612:415-421.

# Exposure to OSS and viruses cause synergized mortality in honey bee larvae

Julia Fine, Diana Cox-Foster, and Chris Mullin Nature Scientific Reports, Jan. 2017





### Do organosilicones affect ALCB nesting?

Leaf pieces vs. pollen- which leads to an effect in ALCB health?

<u>Cage study:</u> Net cages (10x10x6ft) Buckwheat and *Phacelia* plants





Leaves: use buckwheat plants-ALCB will use and flowers are minimal





Pollen/Nectar: *Phacelia*- lots of floral resources, leaves lacy

Cages were sprayed with orgaosilicon (Xiameter OFX-0309 (Silguard)) at a concentration of 625ppm and a rate of 20gal/acre approximately every 1.5 weeks

Four treatments:

- No plants sprayed
- Buckwheat only sprayed (leaves)
- Phacelia only sprayed (pollen/nectar)
- Both plants sprayed (leaves, pollen/nectar)

*Plants not sprayed with organosilicones were sprayed with water as a control* 



## Adding bees and monitoring nesting

- Polystyrene block placed in cage
- 10 female ALCB were released; each had unique color markings
- Observations were taken every two days on bee nesting
- At the end of experiment, offspring were incubated and xrayed every 3 days











#### There were four main larval outcomes















# No effect of treatment on outcome of bee larvae

But- will test levels of OSS and viruses in bees

SAS ver 9.4 PROC GENMOD

Treatment	Number of nests/bee	Average cells in a nest	Max cells in nest
None	1.56±0.51ª b	5.50±2.34ª	6.50±2.42ª
Buckwheat spray (leaves)	1.75±0.64ª	5.10±1.67ª	6.10±1.91ª
Phacelia spray (pollen/nectar)	1.13±0.35 <sup>b</sup>	3.31±1.42 <sup>b</sup>	3.59±1.74 <sup>b</sup>
Both	1.34±0.71ª	3.77±2.48 <sup>b</sup>	4.17±2.80 <sup>b</sup>

SAS ver 9.4 PROC GLM Tukey's post-hoc comparison

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#### "Legless" bees

Seen frequently (~30%) in bees from multiple regions of Alberta over multiple seasons

Seen less frequently in Utah populations



Bees are fully developed but were not able to completely shed cuticle



Symptoms not similar to any pathogen Check for pesticides or adjuvants



FALCON TICON LGON SLANK 60 ALB #8 7.5 75

Working with Dr. Bill Doucette lab (Utah State) to develop analyses for organosilicones and pesticides in these samples





Trisiloxane Oligomers							
Sample	# Replicates	Weight (g) Mean ± std dev	Hydroxy-capped (Oligomers 3-16)	Methoxy-capped (Oligomers 3-15)	Acetoxy-capped (Oligomers 3-15)	Total	
Separated ALCB Nests – Pollen	Duplicate	0.876 ± 0.183	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
Separated ALCB Nests - Leaves	Duplicate	0.909 ± 0.127	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
Alberta Pollen - Batch 1	Triplicate	$1.005 \pm 0.003$	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
Alberta Pollen - Batch 2	Triplicate	1.003 ± 0.002	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
Alberta Pollen - Batch 3	Triplicate	$1.003 \pm 0.001$	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
Alberta Bees - Batch 1	Duplicate	0.497 ± 0.0003	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
Alberta Bees - Batch 2	Duplicate	0.503 ± 0.005	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
Alberta Bees - Batch 3	Duplicate	0.478 ± 0.035	<loq< td=""><td><loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""><td><loq< td=""></loq<></td></loq<></td></loq<>	<loq< td=""><td><loq< td=""></loq<></td></loq<>	<loq< td=""></loq<>	
LOQ	-	-	0.4 - 5.2 ng/g	0.4 – 1.3 ng/g	2.5 - 44.5 ng/g	-	

Range of Trisiloxane Oligomer Recoveries							
Sample	# Sample spiked	Hydroxy-cappedMethoxy-capped(Oligomers 3-16)(Oligomers 3-15)		Acetoxy-capped (Oligomers 3-15)			
200 ng/g spike*							
Separated ALCB Nests – Pollen	1	88 - 109%	82 - 116%	84 -105%			
Separated ALCB Nests - Leaves	1	72 – 105%	67 – 98%	79 - 108%			
Alberta Pollen - Batch 1	1	87 – 105%	65 – 100%	84 - 109%			
Alberta Pollen- Batch 2	1	93 – 113%	72 – 107%	89 - 115%			
Alberta Pollen - Batch 3	1	83 - 113%	91 – 112%	91 - 105%			
Alberta Bees- Batch 1	1	15 – 38%	21 – 33%	8 - 41%			
Alberta Bees- Batch 2	1	12 – 50%	23 – 40%	10 – 50%			
Alberta Bees- Batch 3	1	18 - 41%	19 – 37%	2 – 48%			
4000 ng/g spike*							
Alberta Pollen - Batch 1	1	95 – 104%	92 – 105%	81-100%			
Alberta Pollen- Batch 2	1	91 – 101%	77 – 101%	71 – 101%			
Alberta Pollen - Batch 3	1	94 - 103%	87 – 101%	87 – 101%			
Alberta Bees- Batch 3	1	14 – 40%	20 – 38%	9 – 35%			

\*Spike value represents the total ng/g of each capped trisiloxane, not the ng/g for each individual oligomer e.g. the values for the 200 ng/g spike hydroxyl-capped oligomers 3-16 ranged between 1.3 - 30.5 ng/g

## Chalkbrood control trials



Brio-AG HOCL-potency combines with safety, because of purity



\*Dr. Eric Rasmussen, Briotech CMO, in front of industrial fogger dispensing Brio HOCI @200 ppm Cl



Dr. Jeff Williams, Briotech CSO, treats a space with HOCI from Briotech's proprietary sub-micron droplet fogger



BRIOTECH

Blue orchard bee chalkbrood: 99% spore kill after 10 min of spore contact



### Chalkbrood control trials





- Repeat with ALCB chalkbrood
- Assess safety to bees
- Explore options for decontamination

- Diana Cox-Foster
- Ellen Klinger

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