Pollinators & Pesticides

Communication and Prevention

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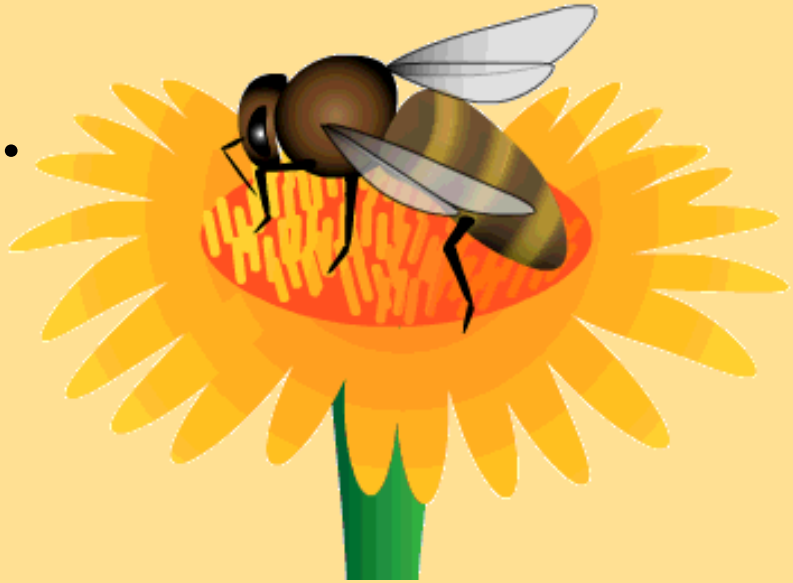
Overview

- Choose products carefully.
- Don’t spray pollinators.
- Don’t spray flowers.
- Communicate.



http://www.about-bees.com/animated-bee.html

Many challenges to pollinators

- Habitat loss and fragmentation
- Climate change and variation
- Pests, pathogens, and diseases
- Pesticides
- Economics of beekeeping

http://apisuk.com/Bees/2012/10/research-proteins-and-varroa/

Plan Ahead

Use PNW591 to compare products for toxicity to pollinators

https://catalog.extension.oregonstate.edu/files/project/pdf/pnw591.pdf

Toxicity and Residual Toxicity

Toxicity Group	Precautionary Statement if Extended Residual Toxicity is Displayed	Precautionary Statement if Extended Residual Toxicity is not Displayed
I Product contains any active ingredient with an acute LD50 of 2 micrograms/bee or less	This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.	Product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are actively visiting treatment area.
II Product contains any active ingredient(s) with acute LD50 of greater than 2 micrograms/bee but less than 11 micrograms/bee.	This product is toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product if bees are visiting the treatment area.	This product is toxic to bees exposed to direct treatment. Do not apply this product while bees are actively visiting the treatment area.
III All others.	No bee caution required.	No bee caution required.

PROTECTION OF POLLINATORS

APPLICATION RESTRICTIONS EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

This product can kill bees and other insect pollinators.

Active Ingredient	Highly Toxic to Bees (RT)	Toxic to Bees (RT)	No Bee Precautionary Statement (PS) on Label	Common Product Names	Notes and Special Precautions
***Chenopodium ambrosioides* extract** *Antifeedant insecticide*			X	Requiem	
Chlorantraniliprole *Anthranilic diamide insecticide: Insect neurotoxin affecting muscle regulation, causing paralysis and death*			X	Altacor, Acelepryn, Coragen, Grubex	No impact on bumble bees [14].
Chlorfenapyr *Pyrrole insecticide/acaricide, metabolic poison*		X <4 hours RT [1] Foraging behavior may be affected > 2 days [10] *Can vary with formulation and application rate*		Phantom, Pylon	8 hour ERT for alfalfa leafcutting bees[1]. Incompatible with bumble bees [2].
Chlorothalonil *Chloronitrile fungicide*			X?	Bravo, Echo, Daconil, Equus, Legend	Tentatively associated with "entombed pollen" [15]. Common contaminant of beeswax [6].
Chlorpyrifos *Organophosphate insecticide*	X EC 4-6 days ERT, ULV 0.05 lb ai/acre or less <2 hours RT [1] *Can vary with formulation and application rate*			Dursban, Cobalt, Lorsban Bees unlikely to be exposed to granular formulations	Up to 7 day ERT for alfalfa leafcutting bees, 3-6 days ERT for alkali bees [1]. Common contaminant of beeswax [6]. Incompatible with bumble bees [2].
Chromobacterium subtsugae *Insecticide derived from bacteria, acts through complex mechanism of action*		X Yes		Grandevo	Length of residual toxicity to bees unknown.
Cinnamaldehyde *Cinnamon flavoring, insecticide, miticide, fungicide*			X	Cinnacure	

Insecticides used in cranberries

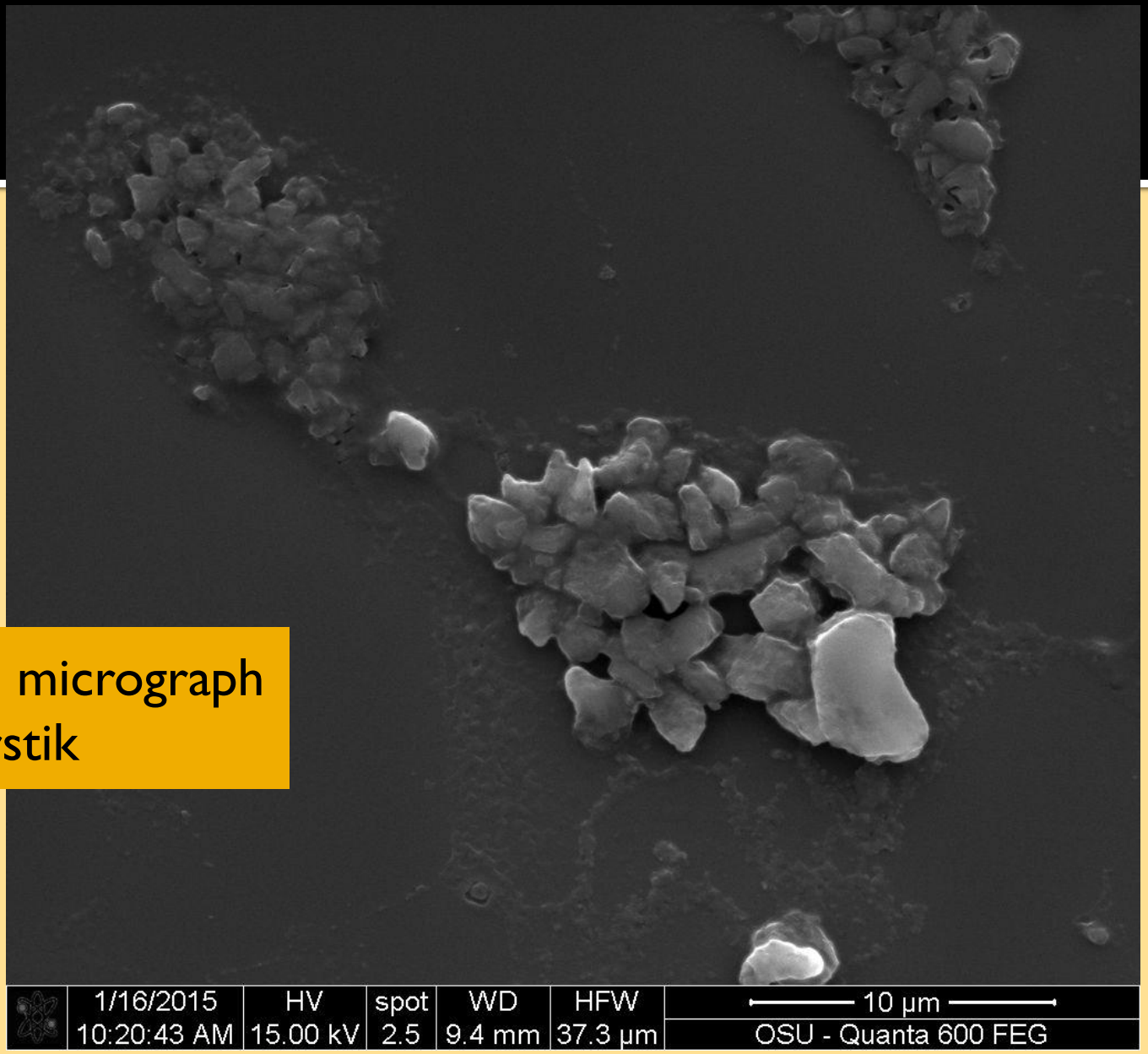
INSECTICIDES	Active	Bee Caution?	Impacts on other Bees?
Altacor	Chlorantraniliprole	No bee caution	No
Orthene	Acephate	Highly Toxic ERT	Yes
Avaunt	Indoxacarb	Highly Toxic RT	Yes
Delegate	Spinetoram	Moderately Toxic RT	
Diazinon	Diazinon	Highly Toxic RT	Yes
Assail	Acetamiprid	Moderately Toxic RT	Yes
Belay	Clothianidin	Highly Toxic ERT	Yes

Synergy between IGRs and Fungicides?
Think before you mix!

IGR	Active	Bee Caution?	Impacts on other Bees?
Intrepid	Methoxyfenozide	No bee caution	No

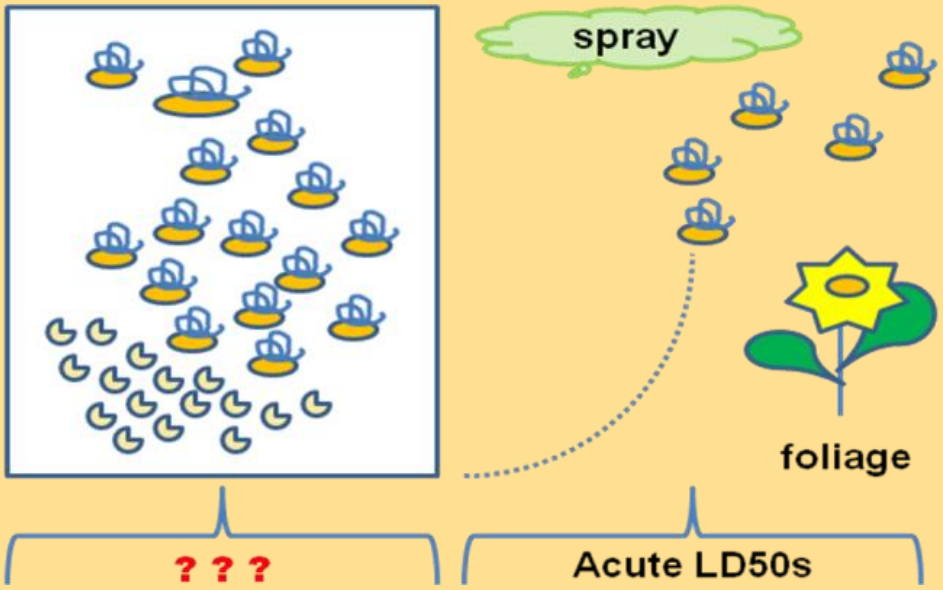
FUNGICIDES	Active	Bee Caution?	Impacts on other Bees?
Bravo	Chlorothalonil	No bee caution	Maybe
Abound	Azoxystrobin	No bee caution	
Indar	Fenbuconazole	No bee caution	
Manzate	Mancozeb	No bee caution	
Proline	Prothioconazole	No bee caution	
Champ, Kocide	Copper Hydroxide	Moderately Toxic	

Scanning electron micrograph of Bravo Weatherstik

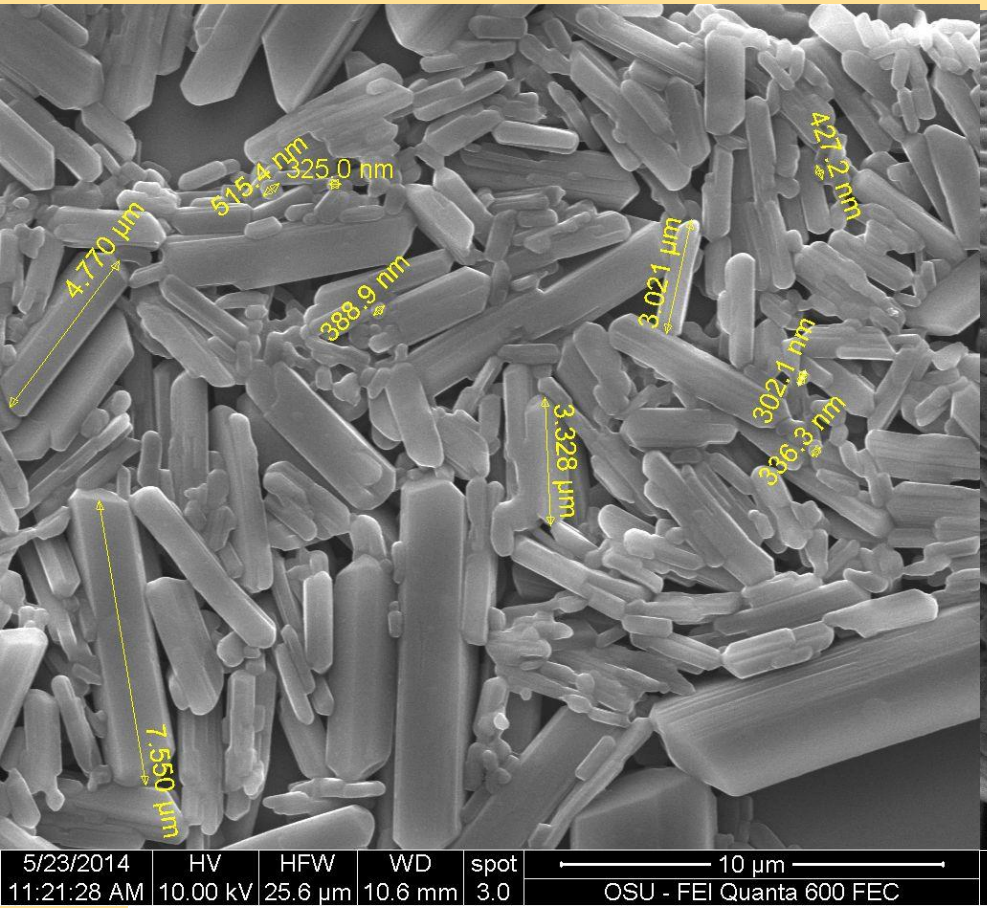


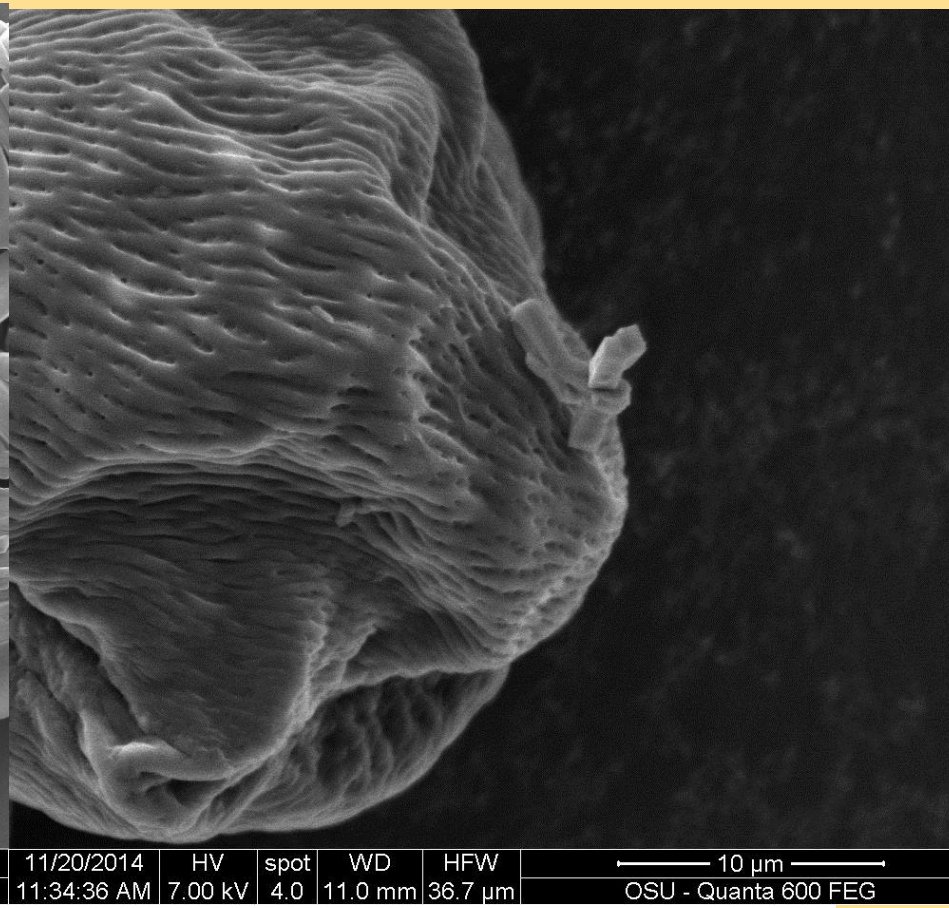
Uncertainties

- Evaluating toxicity of pesticides starts with toxicity to adult bees.
- What about larvae, queen, and drones?
- What about native bees?



Some fungicides may cause delayed effects to development (eggs, larvae, capped)





Choose products carefully

- **Lowest toxicity to pollinators.**
- **Shortest residual toxicity.**

Western White Tailed Bumble Bee

http://www.oregonherald.com/oregon/local.cfm?id=4626

Causes of pesticide poisoning to bees

- Misapplication.
- Drift or overspray onto blooming plants and weeds.
- Insecticides applied when bees are foraging.
- Leaky drip tape or chemigation systems.

Bees need clean water.

http://thebeespace.net/2008/08/10/hot-weather-nectar-flow-busy-bees/

Don’t spray pollinators

- If you must spray during bloom, check the label.
- If no bee precaution on label, err on the side of caution by spraying at night

Timing

- Spray at night.

Residual Toxicity (RT)	Application time
Greater than 8 hours – extended residual toxicity (ERT)	Do not apply when hives are in area Ask beekeeper to relocate bees (may not be always feasible) Allow sufficient time between application and arrival of bees
4 to 8 hours residual toxicity	Late evening or night (after bees cease foraging) until midnight
Less than 4 hours residual toxicity	Late evening or night (after bees cease foraging) to first light
No residual toxicity	Late evening or night (after bees cease foraging) to early morning (before bees begin foraging) Depends on weather Depends on daily bee foraging pattern for each crop

Don’t spray Pollinators

- Even when cranberries aren’t blooming, weeds can be.
- Look for pollinators before spraying!

Don’t spray flowers

- If it blooms, they will come!
- Control flowering weeds before spraying insecticides

http://www.nwplants.com/business/catalog/rub_spe.html

Consider formulation

Pesticide formulation	Bee exposure	Special precautions
Microencapsulated, dust, wettable powder, flowable	Particles similar in size to pollen, stick to bee hairs, and can be taken to hive and fed to brood	Avoid weather conditions that increase drift of dust.
Emulsifiable concentrate	Direct spray and residues	Ultralow volume (ULV) formulations may be more hazardous than other liquid formulations.
Solution, soluble powder	Direct spray and residues	Ultralow volume (ULV) formulations may be more hazardous than other liquid formulations. Chemigation drips or puddles may attract bees.
Seed coatings	Applied directly to seed. Ideally, bee exposure not expected	Can transfer to talc during planting and drift onto blooming crops, weeds, or adjacent habitat.
Granular	Applied to soil, honey bees do not pick up	Avoid applying near known nesting beds of ground nesting bees, such as the alkali bee.
Systemic (soil, injection, or foliar applications absorbed by plant)	Some systemic insecticides may translocate to nectar, pollen, and guttation droplets, and can be ingested by bees.	Whether field concentrations are high enough to adversely affect bee colonies is a subject of research.

Before you apply

- Look for managed bees in the area.
  - Your crop
  - Your neighbor's crops
  - Your neighbor's backyard
- Ideally, the beekeeper has posted his phone number on or near his/her hives.
- Apiaries may also be registered with ODA.

Communicate with Beekeepers

- Product and active ingredient
- Potential toxicity
- Residual toxicity
- When spray will occur
  - Can they delay bringing hives?
  - Can hives be moved?
  - Covering hives not very realistic
- Reentry Interval

Get information from Beekeepers

- When are hives arriving and leaving?
- Where will hives be placed?
- Are hives marked with phone number?
- Registered with ODA?

Sharing Agricultural Landscapes

- Managed Bees
  - Can be moved
  - Can be replaced
- Native Pollinators
  - Are particularly important for pollinating cranberries!
  - Cannot move
  - May need habitat
  - Cannot be replaced quickly

http://en.wikipedia.org/wiki/Bumblebee


www.capitalpress.com

What does pesticide poisoning look like?

- Excessive numbers of dead and dying honey bees in front of the hives
- Odd behavior: increased defensiveness, lethargy, stupefaction, or paralysis; or abnormally jerky, wobbly, or rapid movements; spinning on the back
- Please call your beekeeper immediately!

http://foodfreedomgroup.com/2013/11/25/bayer-syngenta-sue-eu-to-overturn-ban-on-bee-killing-pesticides/

Reporting problems

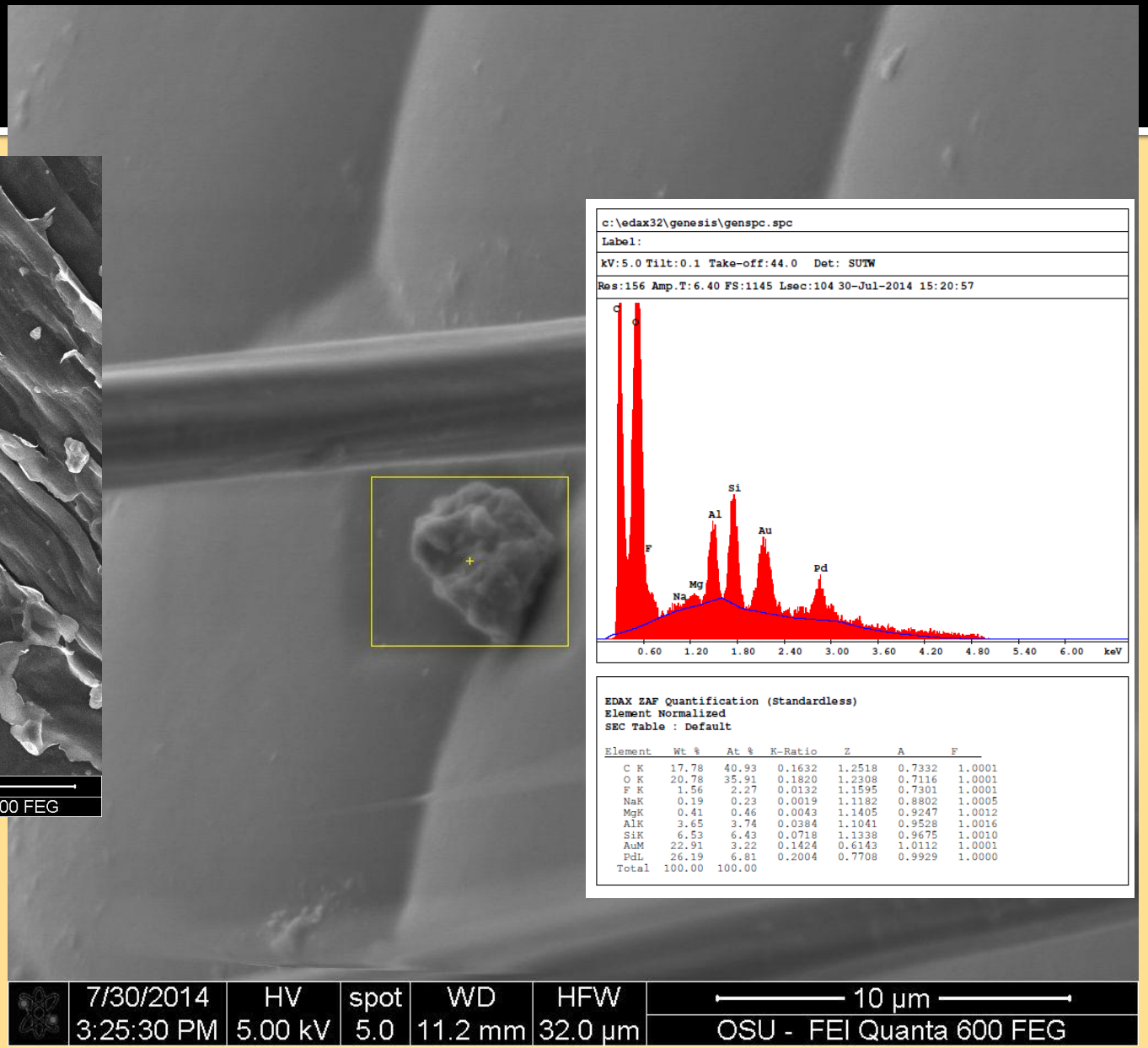
- You followed the label.
- Bees appear to be suffering from pesticide poisoning.
- Work with beekeeper to report it!
  - ODA
  - EPA
  - NPIC
  - OSU Bee Lab

Carrot Pollination

Beleaf SG (Soluble Granule)

Dogwood pollen

Beleaf



Beleaf transfers readily to bees

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Foothills Honey

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Queen Bee Apiaries

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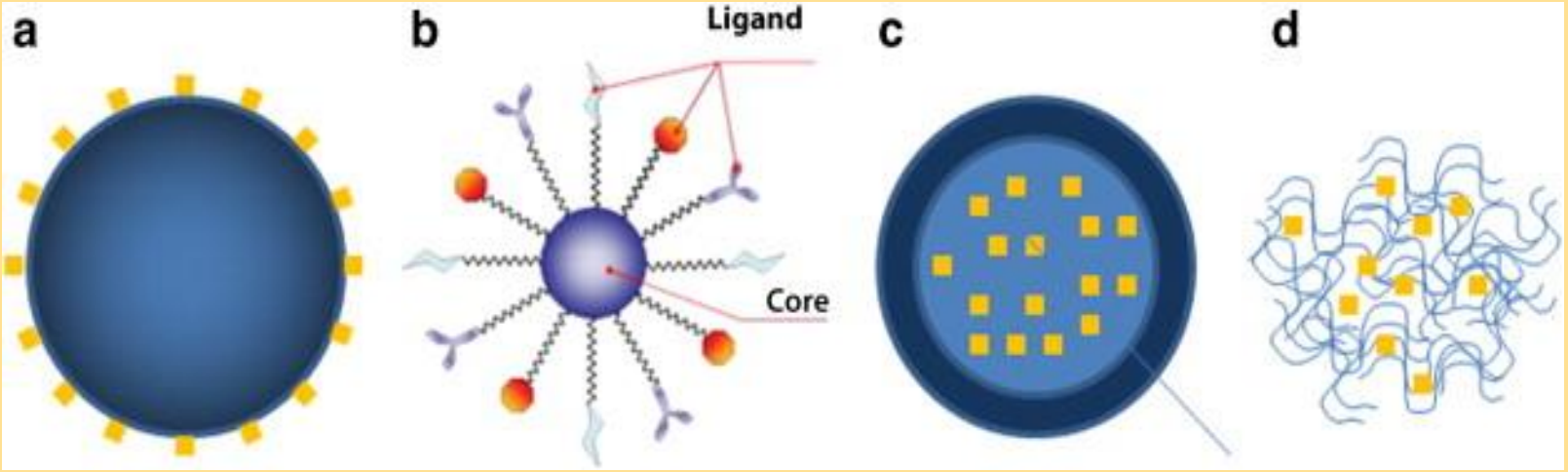
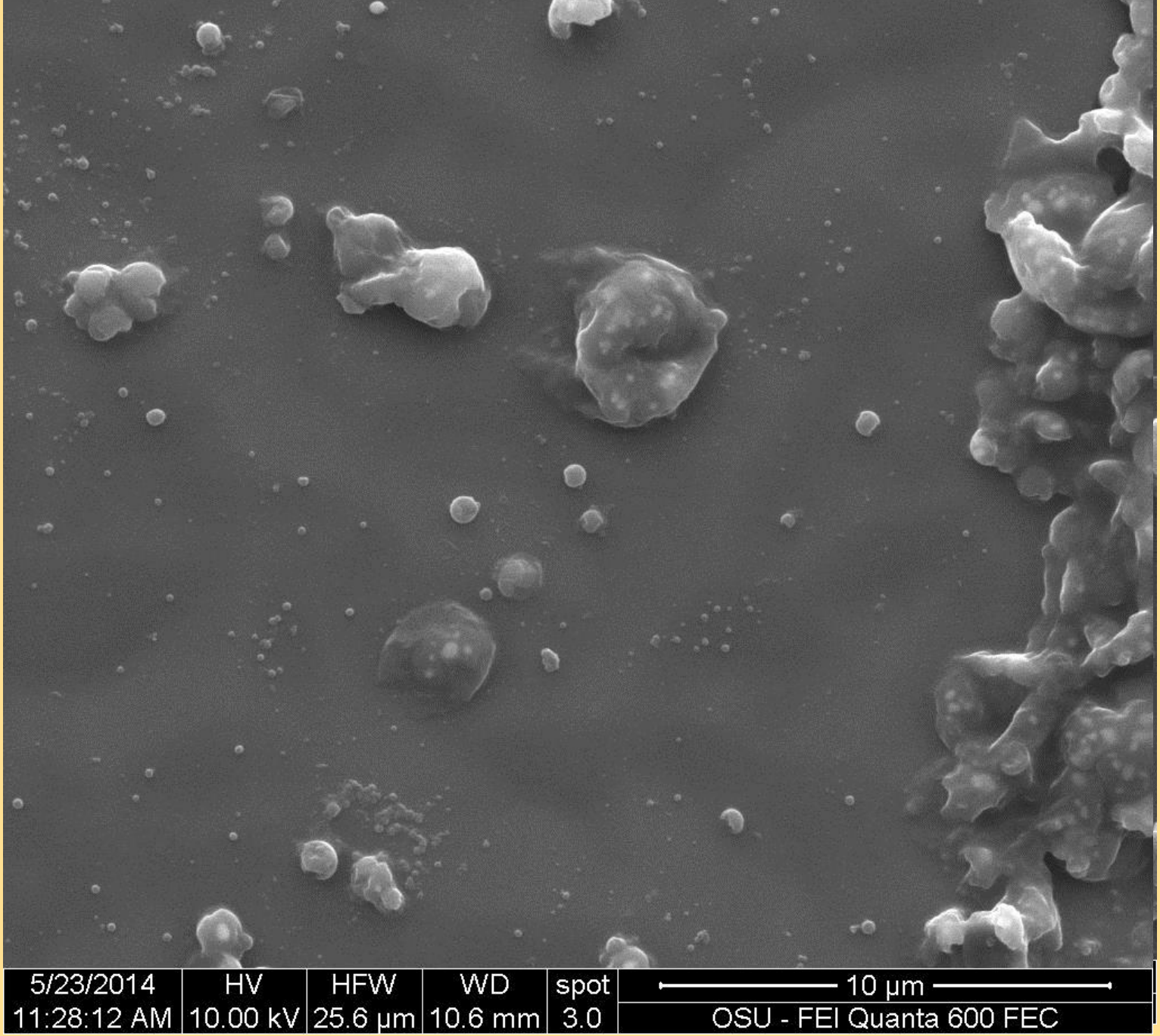
Nanoenabled Pesticide Formulations

- Pesticide adsorption on nanoparticle
- Attachment mediated by ligands
- Encapsulation
- Entrapment in polymer




5/23/2014
11:28:12 AM
HV
10.00 kV
HFW
25.6 µm
WD
10.6 mm
spot
3.0
10 µm
OSU - FEI Quanta 600 FEC

Nanoenabled pesticide particles are smaller than pollen grains

Particle type	Diameter Range
Nanosilver	1-100 nm
Diesel exhaust	7.5-1000 nm
PM0.1 (ultrafine particles)	100 nm
Fugitive dust from seed planting **Nanopesticide particles approximate lower range**	0.23-32 μm
PM2.5 (fine particles)	2.5 μm
Nanopesticide particles upper range	1-10 μm
PM10 (coarse particles)	10 μm
Pollen **Microencapsulated methvl parathion (PENNCAP-M)**	6-100 μm

New properties

- Solubility and stability of hydrophobic active ingredients in water
- Resistance to degradation

Longer residual toxicity to bees?

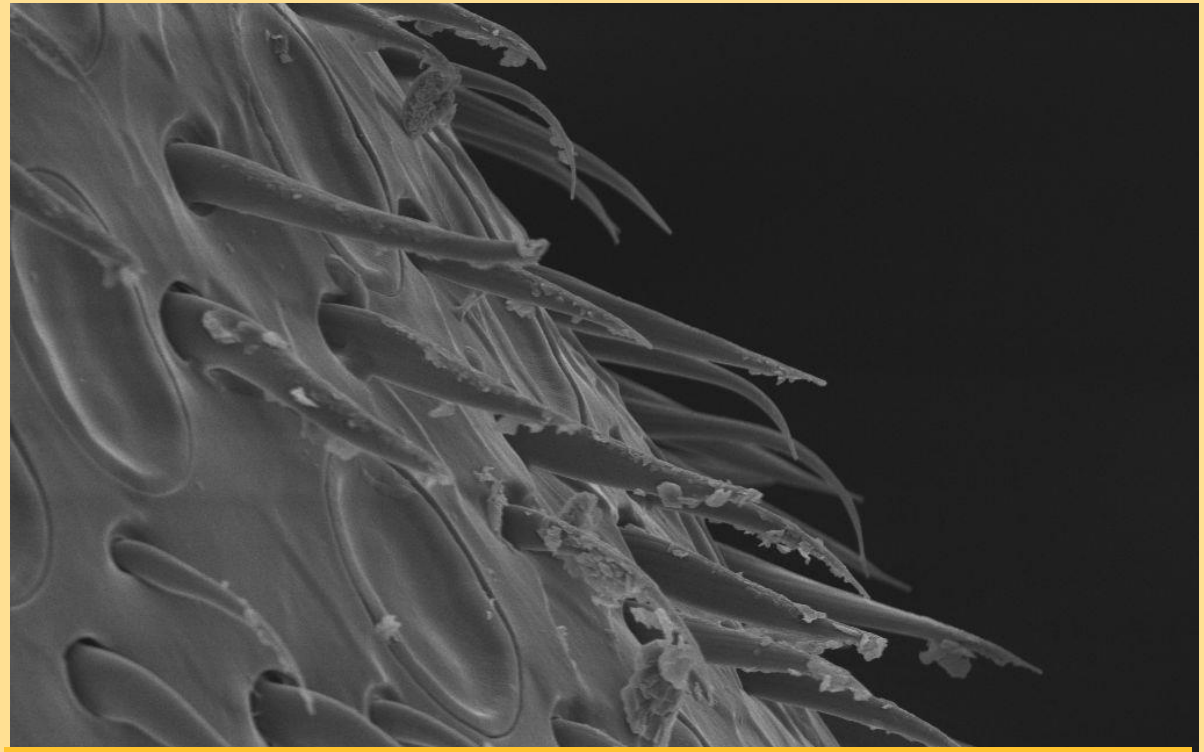
Altered adherence to bees?

Movement/persistence in colony materials?

Do nanoenabled formulations increase risk of pesticide effects to bees?

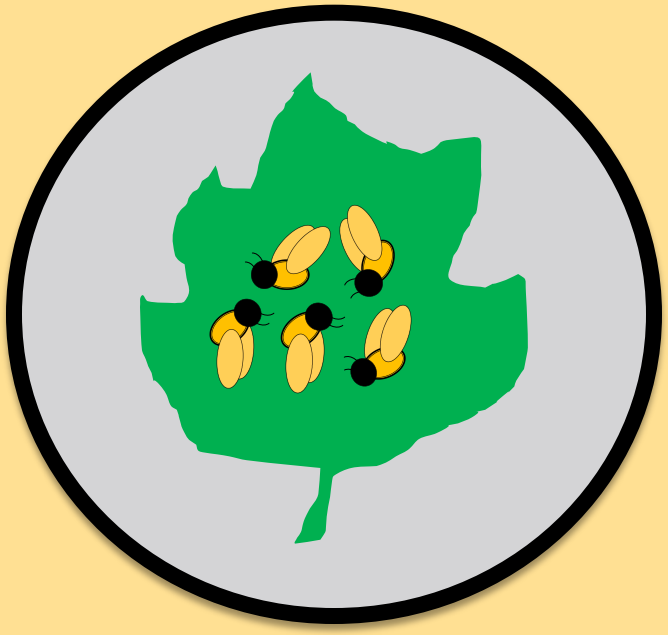
Do nanoenabled pesticide particles adhere to bees similarly to pollen grains?

Do nanoenabled pesticide particles stick to bees and pollen?



Nanoenabled pesticide particles vary in their ability to adhere to bees and pollen

Transfer from foliage to bees



- Do nanoenabled pesticide particles transfer to bees?
- How long do particles persist compared to active ingredients?

Nanoenabled pesticide particles vary in their ability to transfer from leaves to bees

Carrot Pollination

Beleaf SG (Soluble Granule)

Dogwood pollen

Beleaf

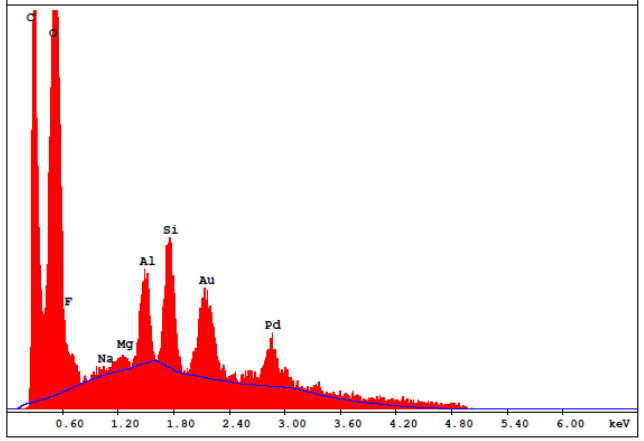
Beleaf transfers readily to bees

c:\edax32\genesis\genspc.spc

Label:

kV:5.0 Tilt:0.1 Take-off:44.0 Det: SUTW

Res:156 Amp.T:6.40 FS:1145 Lsec:104 30-Jul-2014 15:20:57



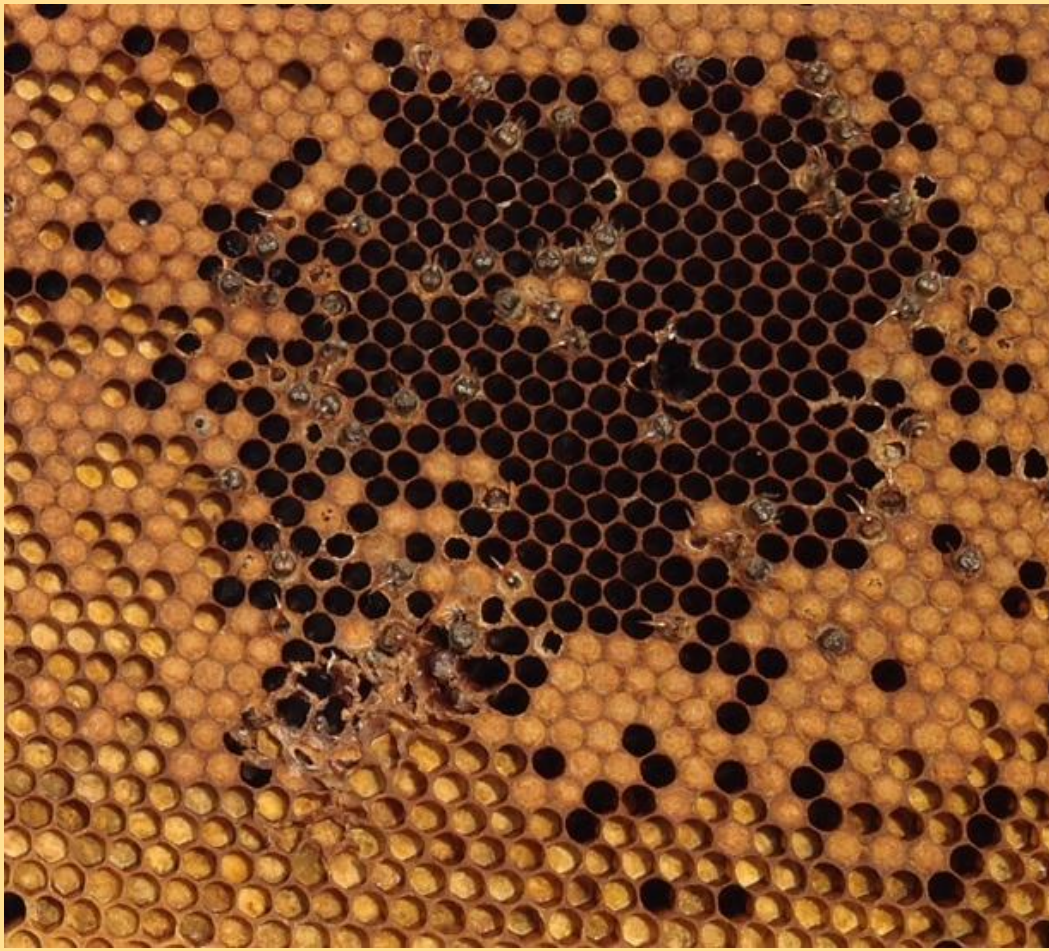
EDAX ZAF Quantification (Standardless)
Element Normalized
SEC Table : Default

Element	Wt %	At %	K-Ratio	Z	A	F
C K	17.78	40.93	0.1632	1.2518	0.7332	1.0001
O K	20.78	35.91	0.1820	1.2308	0.7116	1.0001
F K	1.56	2.27	0.0132	1.1595	0.7301	1.0001
NaK	0.19	0.23	0.0019	1.1182	0.8802	1.0005
MgK	0.41	0.46	0.0043	1.1405	0.9247	1.0012
AlK	3.65	3.74	0.0384	1.1041	0.9528	1.0016
SiK	6.53	6.43	0.0718	1.1338	0.9675	1.0010
AuM	22.91	3.22	0.1424	0.6143	1.0112	1.0001
PdL	26.19	6.81	0.2004	0.7708	0.9929	1.0000
Total	100.00	100.00				

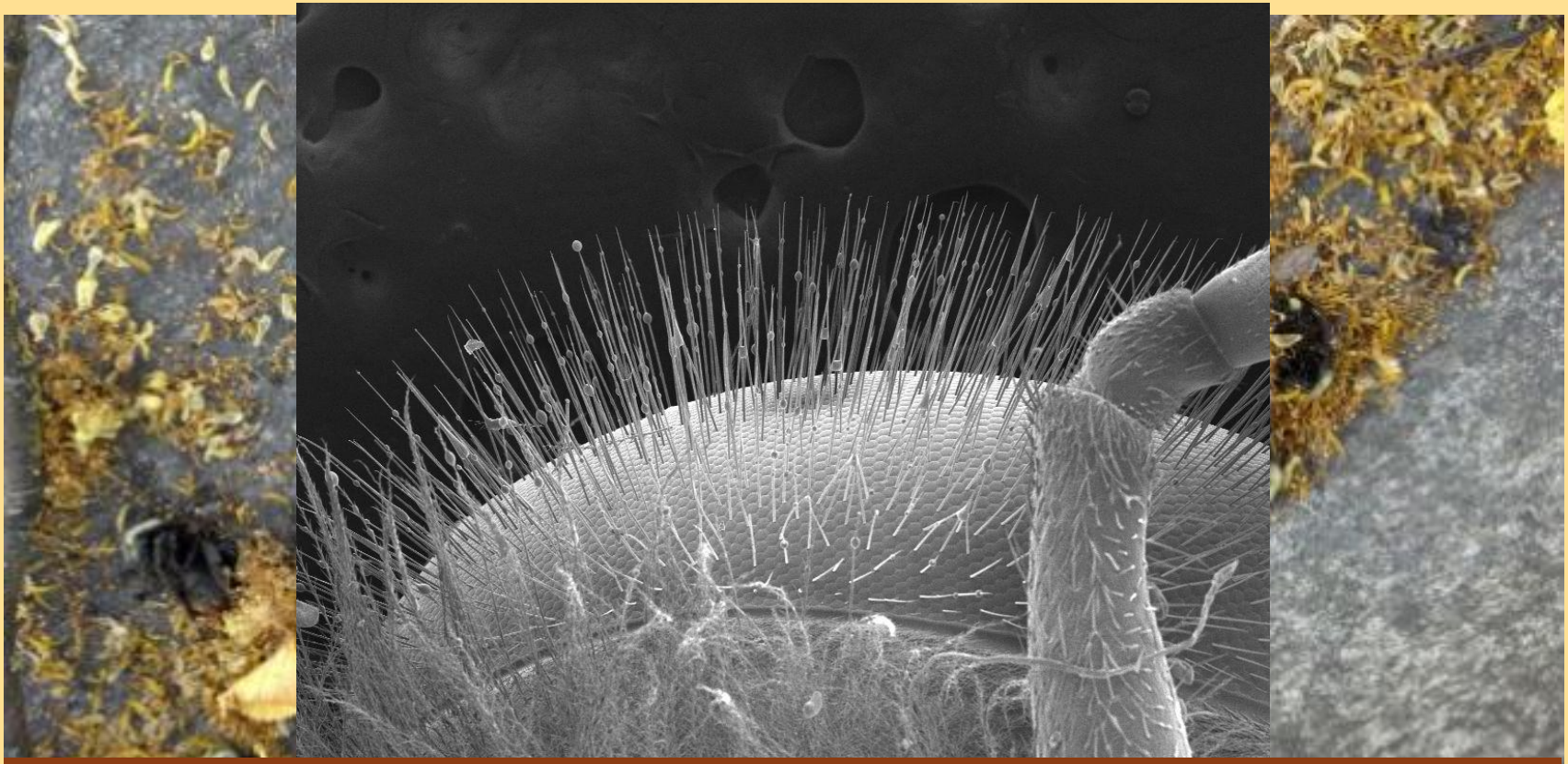
7/30/2014	HV	spot	WD	HFW	10 µm
3:25:30 PM	5.00 kV	5.0	11.2 mm	32.0 µm	OSU - FEI Quanta 600 FEG

2014 Bee Die-off in Almonds

- 80-100,000 colonies
- Delayed effects

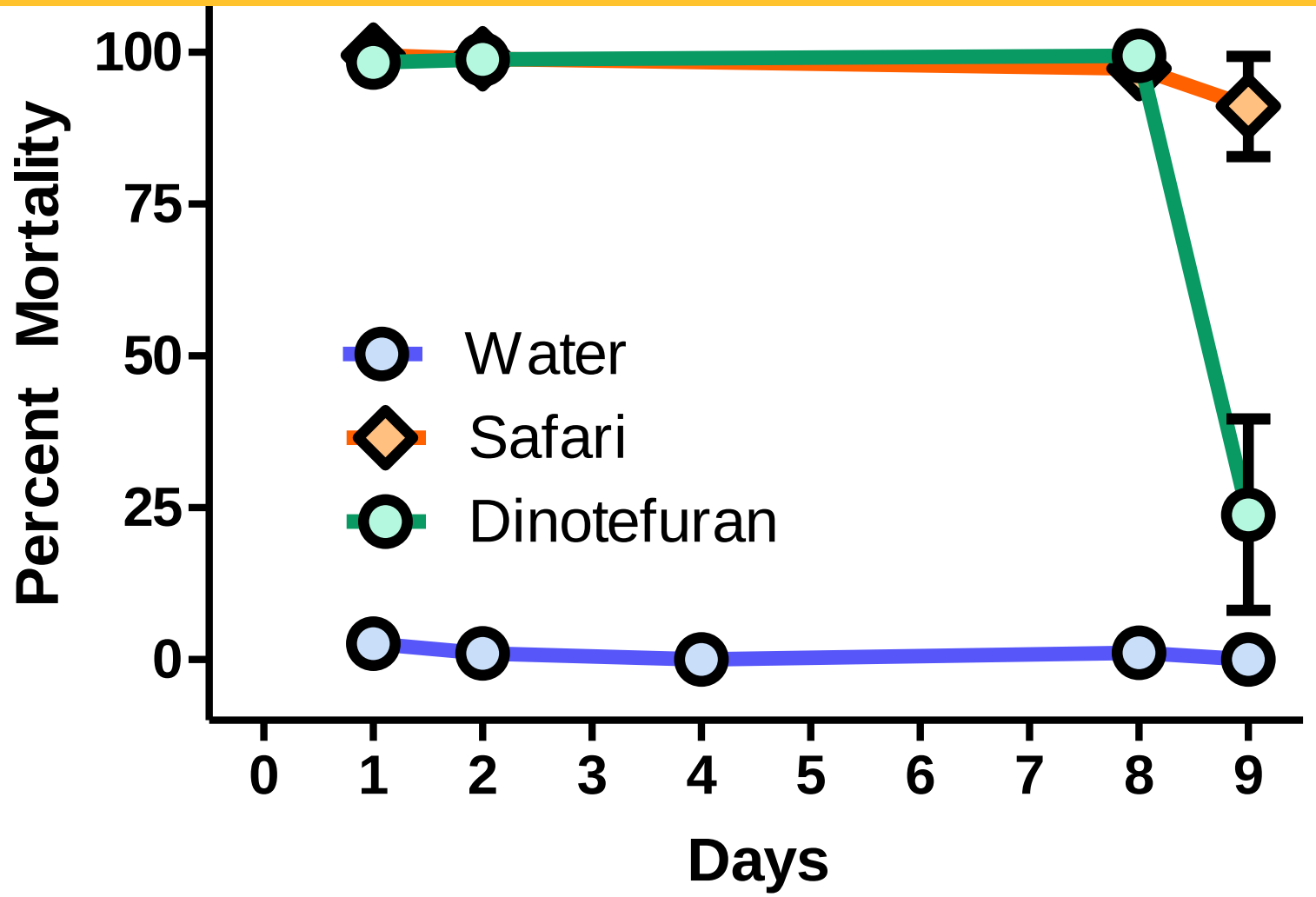


Safari (dinetofuran)



Do nanoenabled pesticides alter residual toxicity to bees?

Residual toxicity is longer for formulated Safari than it is for the active ingredient



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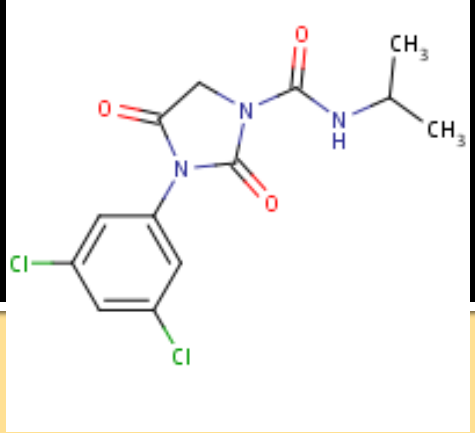

Iprodione

- Inhibits germination of spores and growth of fungal mycelium
- Found in pollen and wax
- Likely to be carcinogenic to humans
- Moderately toxic to fish
- Highly toxic to aquatic invertebrates
- May have endocrine effects and affect cytochrome P450s in vertebrates
- Toxic to developing bee larvae in laboratory studies