bee care

Science For A Better Life

Neonicotinoid Residues in Pollen and Nectar of Food Crops

Ornamental Horticulture Workshop
December 15, 2014

David L. Fischer, Ph.D.
Director, Pollinator Safety.
Bayer CropScience LP

Why measure pollen and nectar residue levels?

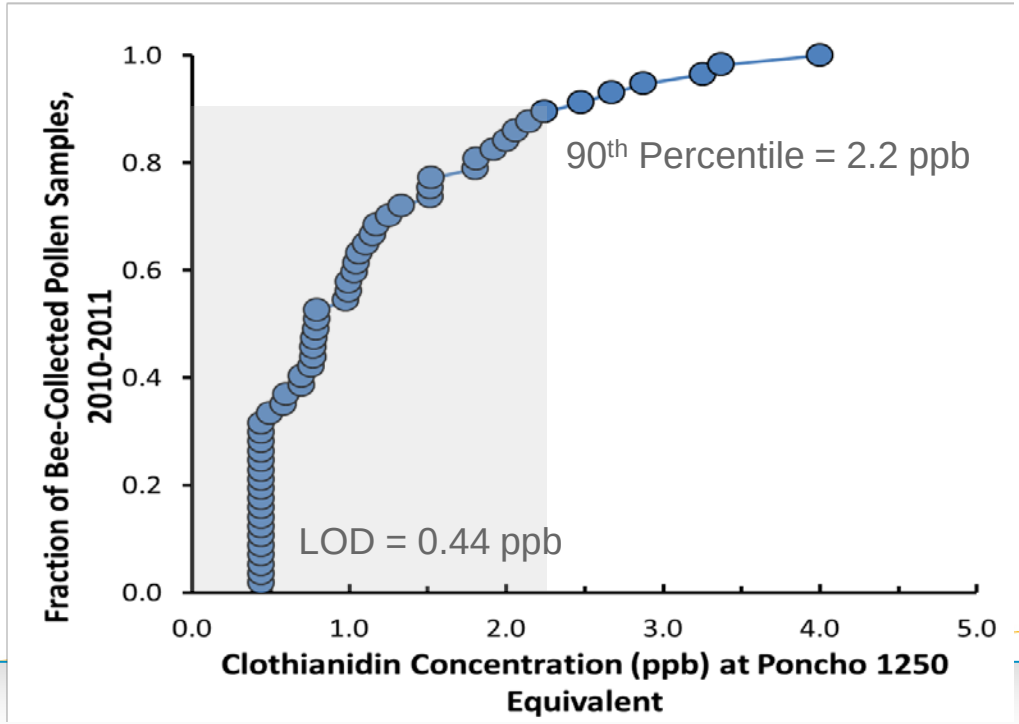
- For systemic products that are not applied as a foliar spray, the main route of exposure for bees is via their diet
- Dietary exposure may also be an important route of exposure for products that are applied as a foliar spray
- Although EPA has a Tier 1 approaches for estimating residue levels in pollen and nectar, these are designed to overestimate real-world exposures
- Field measurements may allow a probabilistic characterization of exposure, which results in a for a more informative risk assessment

“Begin with the end in mind”

- What are we going to do with the measurement data?
  - Derive a point estimate of exposure to replace the Tier 1 estimate?

    90% percentile of measurements for the replicate site with the highest measured residues

  - Develop a probability distribution?



Summary of neonicotinoid residue levels in pollen and nectar of treated food crops: I. Seed Treatment Uses

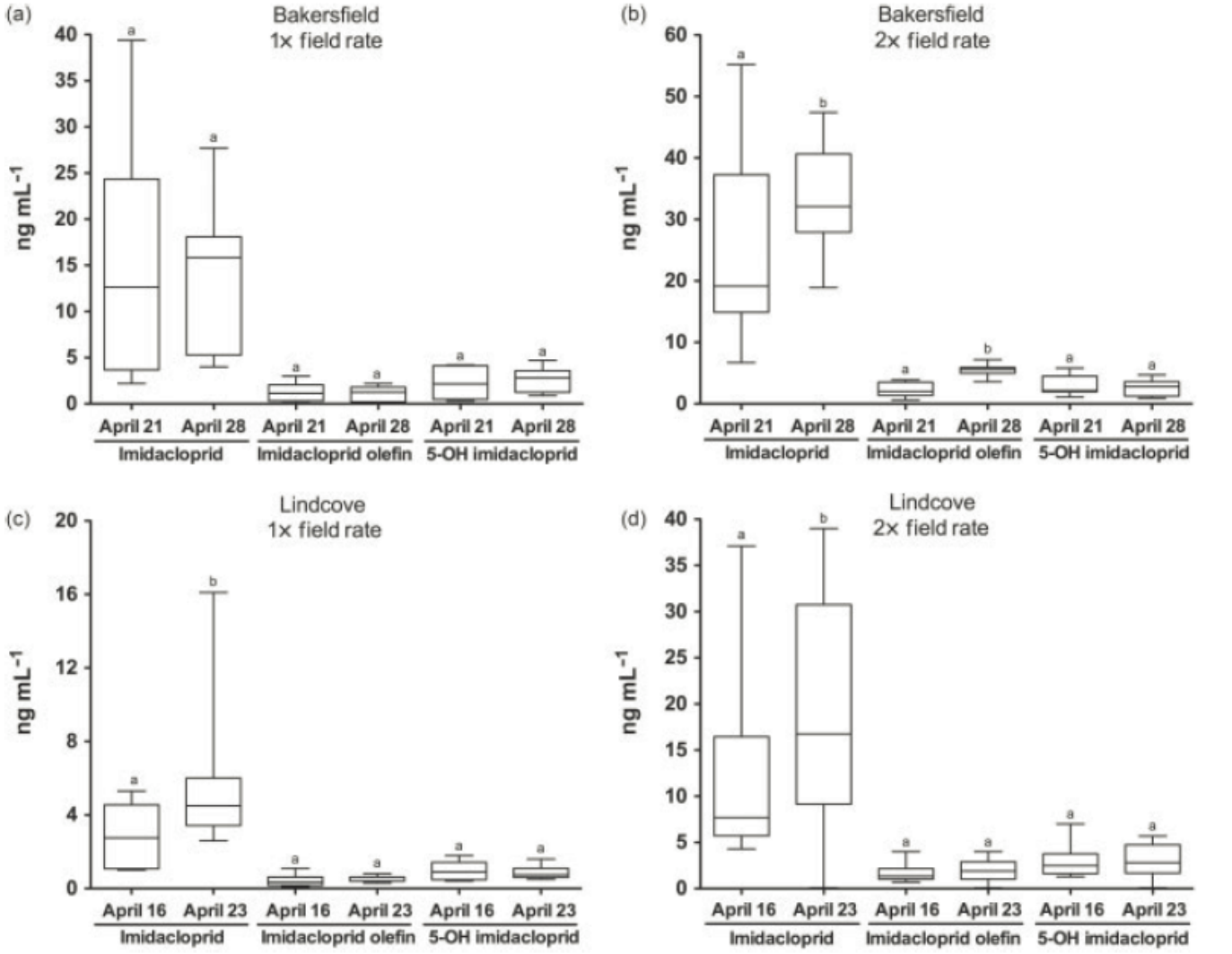
Crop	Compound	Application Rate	Pollen (ug/kg)	Nectar (ug/kg)
Oil-seed Rape/ Canola	Clothianidin	600 g ai/cwt seed	<0.5 to 6.2	<0.5 to 8.6
		400 g ai/cwt seed	Mean = 1.7 95%le = 3.9	Mean = 0.8 95%le = 1.4
	Imidacloprid	454 g ai/cwt seed	1.3 – 3.0	0.3 – 3.0
Sunflower	Imidacloprid	0.7 mg ai/seed	<0.5 to 3.4	<0.5 to 1.9
Maize	Clothianidin	0.5 mg ai/seed [hand-collected]	Mean = 4.4 90%le = 9.2	N/A N/A
		1.25 mg ai/seed [bee-collected]	Mean = 1.2 90%le = 2.2	N/A N/A
	Imidacloprid	1.34 mg ai/seed	3.0 – 15.0	N/A

Summary of neonicotinoid residue levels in pollen and nectar of treated food crops: II. Soil-drench

Byrne et al. 2013

CA Citrus

Imidacloprid soil drench 1-2 mos before bloom

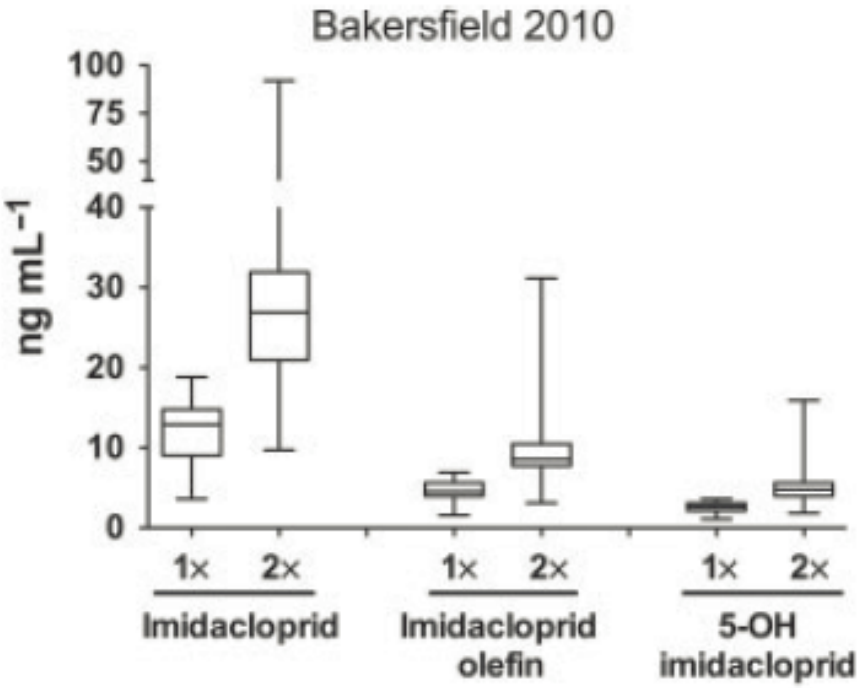


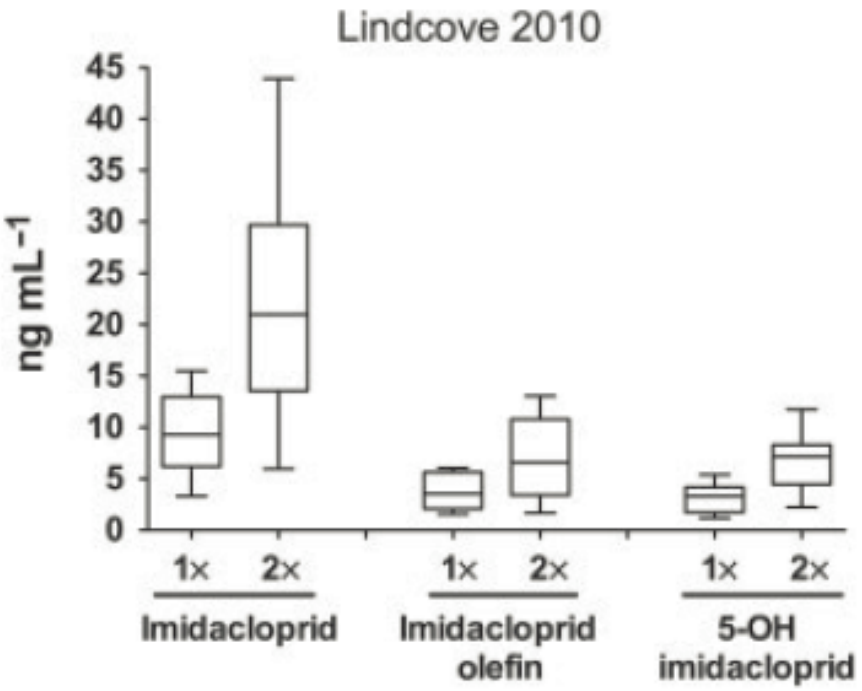
II. Soil-drench

Byrne et al. 2013

CA Citrus

Imidacloprid soil drench 6-7 mos before bloom





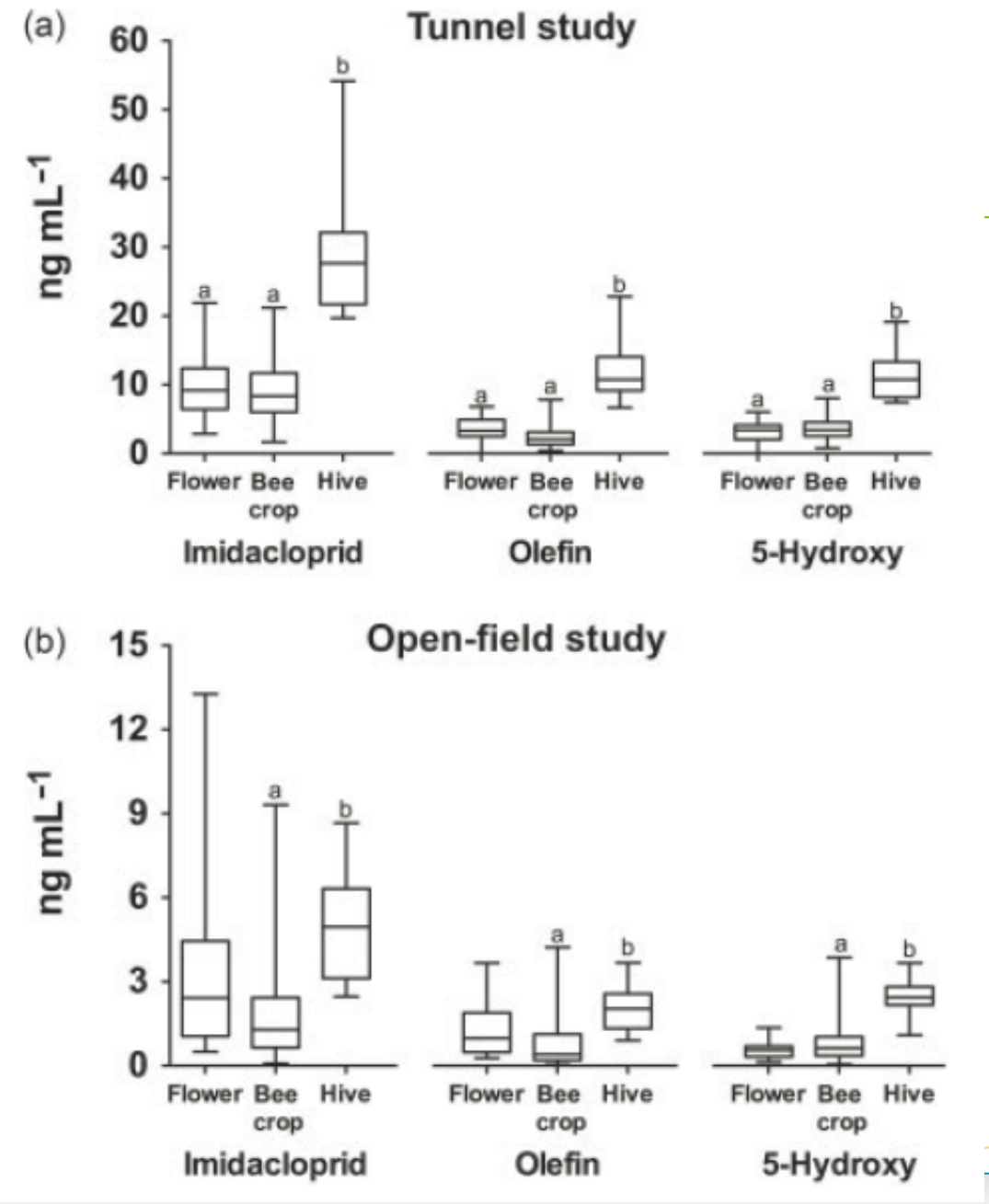
II. Soil-drench

Byrne et al. 2013

CA Citrus

Imidacloprid soil drench 6-7 mos before bloom

Similar residue levels for nectar sampled from flowers and forager bees (forced regurgitation); higher residues in hive-deposited nectar (water evaporation).



II. Soil-drench and foliar Pumpkins

Dively and Kamel 2012. Residues in **Pollen** – Year 1

insecticide	treatment regimen	parent compound (ng/g) mean[b]	min	max
imidacloprid, LOD = 0.2 ng/g	bedding drench	4.9 c	3.3	6.7
	transplant (low)	36.7 b	30.1	40.1
	transplant (high)	60.9 ab	40.5	86.6
	transplant-drip	80.2 a	52.3	101.0
dinotefuran, LOD = 0.2 ng/g	transplant-drip	57.5 a	44.0	69.2
	two foliar	88.3 a	36.0	147.0
thiamethoxam, LOD = 0.2 ng/g	transplant-drip	68.0 a	54.8	90.4
	two foliar	95.2 a	60.7	127.0

II. Soil-drench and foliar Pumpkins

Dively and Kamel 2012. Residues in **Pollen** - Year 2

insecticide	treatment regimen	parent compound (ng/g) mean[b]	min	max
imidacloprid, LOD = 0.2 ng/g	bedding drench	0.1[c] c	0.1	0.1
	transplant (low)	18.2 ab	13.2	23.9
	transplant-drip	31.8 a	23.9	44.0
dinotefuran, LOD = 0.2 ng/g	transplant-drip	15.2 ab	11.6	19.3
	one foliar	11.2 b	8.0	13.5
	two foliar	34.7 ab	7.6	79.5
thiamethoxam, LOD = 0.2 ng/g	seed treatment	0.1 c	0.1	0.1
	transplant-drip	24.8 ab	17.3	33.2
	one foliar	15.3 ab	13.9	16.8
	two foliar	25.2 ab	18.1	29.6
oxamyl, LOD = 7 ng/g	two drip	3.5 c	3.5	3.5
	three drip	3.5 c	3.5	3.5

II. Soil-drench and foliar Pumpkins

Dively and Kamel 2012. Residues in **Nectar** – Year 1

insecticide	treatment regimen	parent compound (ng/g) mean[b]	min	max
imidacloprid, LOD = 0.2 ng/g	bedding drench	0.4 c	0.3	0.5
	transplant (low)	5.7 b	3.8	7.3
	transplant (high)	7.4 ab	4.7	11.9
	transplant-drip	11.2 a	9.0	13.7
dinotefuran, LOD = 0.2 ng/g	transplant-drip	9.2 a	7.1	10.6
	two foliar	7.5 a	5.3	10.8
thiamethoxam, LOD = 0.2 ng/g	transplant-drip	9.5 a	7.8	12.2
	two foliar	8.2 a	6.7	9.1

II. Soil-drench and foliar Pumpkins

Dively and Kamel 2012. Residues in **Nectar** – Year 2

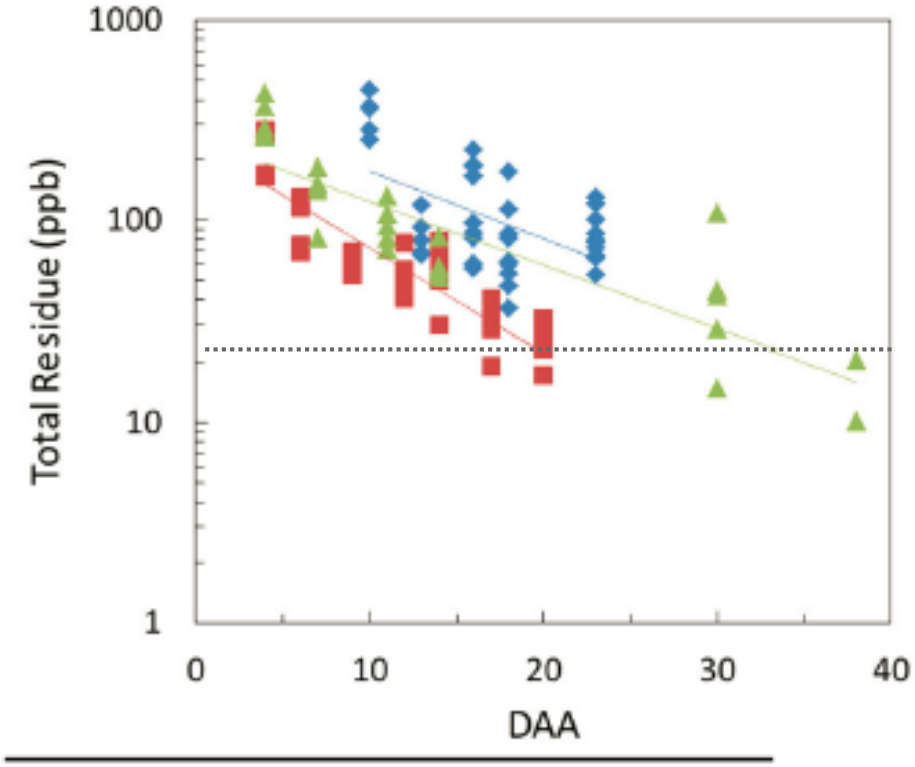
insecticide	treatment regimen	parent compound (ng/g) mean[b]	min	max
imidacloprid LOD = 0.2 ng/g	bedding drench	0.1[c] c	0.1	0.1
	transplant (low)	6.1 ab	4.8	6.7
	transplant-drip	9.1 a	6.7	16.0
dinotefuran, LOD = 0.2 ng/g	transplant-drip	4.8 abc	0.1	10.9
	one foliar	2.1 bc	0.1	5.0
	two foliar	7.0 ab	0.1	16.0
thiamethoxam, LOD = 0.2 ng/g	seed treatment	0.1 c	0.1	0.1
	transplant-drip	10.7 a	9.0	15.1
	one foliar	1.6 bc	0.1	2.5
	two foliar	4.3 ab	3.0	7.0
oxamyl, LOD = 7 ng/g	two drip	3.5 c	3.5	3.5
	three drip	3.5 c	3.5	3.5

III. Foliar – Residue Decline

BCS (2014)

FL Citrus

Imidacloprid applied prior to bloom (DAA = days after application samples were taken)



Summary

- Residue studies should be designed to determine the probability distribution of potential exposure levels
- Pollen and nectar residue levels vary by application method. All other things being equal, ST < Soil Drench < Foliar
- Systemic uptake and translocation of neonicotinoids varies with plant species, soil type and weather (year to year differences)
- Measurements of sample collected by hand from flowers may or may not be representative of measurements from bees or from hive comb