

1 **Concentrations of Neonicotinoid Insecticides in Honey, Pollen and Honey Bees**
 2 **(*Apis mellifera* L.) in Central Saskatchewan, Canada**

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4 **Supporting Information**

5 SI Table 1: LOQ and Transition Ions for detection of Neonicotinoids (NIs) by LC-MS/MS

	LOQ		LOQ	
	ng mL ⁻¹	IONS	ng mL ⁻¹	IONS
<i>Neonicotinoids (NIs)</i>				
Acetamiprid	0.1	223.1 / 126.0	0.5	223.1 / 99.0
Clothanidin	0.4	250.2 / 169.0	0.5	250.2 / 131.9
Imidacloprid	0.6	256.1 / 209.0	2.0	256.1 / 175.1
Thicloprid	2.0	253.1 / 98.9	0.5	253.1 / 125.9
Thiamethoxam	2.0	291.9 / 181.0	1.0	291.9 / 211.0
d3-clothiandin	0.5	253.1 / 132.0	0.5	253.2 / 98.2
Nitenpyram	2.0	271.0 / 99.0	2.0	271.0 / 225.0
d4-imidacloprid	6.0	261.2/180.1	0.5	261.2/214.1
<i>Imidacloprid metabolites</i>				
olefin	0.5	254.07/205.17	0.5	254.07/171.07
5-hydroxy	1.0	272.14/190.99	1.0	272.14/225.08
urea	1.0	212.10/128.1	1.0	212.10/78.01
desnitro olefin	1.0	209.08/125.97	1.0	209.08/90.03
desnitro HCL	1.5	211.10/126.00	1.5	211.10/90.03
6-chloronicotinic acid	1.0	157.90/77.90	1.0	157.90/121.95

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8 **SI Table 2:** Trade names and the active ingredient of neonicotinoid insecticides (NIs) used in
 9 Canada as of 2014.

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Active Ingredient (NI)	Trade Name	Mode of Action
Thiamethoxam	Helix, Cruiser Actara 240SC Actara 25WG	Ingestion/contact
Imidacloprid	Admire, Alias, Grapple, Grapple2, Gaucho, Raxil ProShield, Sombrero, Stress Shield 600	Contact/ ingestion (flowable formulations) ingestion (seed treatments)
Acetamiprid	Assail	Contact/ ingestion
Clothianidin	Prosper, Poncho, Titan, Clutch	Ingestion

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12 **SI Table 3:** Neonicotinoid insecticides (NIs) used in a range of crops as supplied by the
 13 Saskatchewan Governments agriculture ministry.

Trade Name	Active Ingredient	Application	Trade Name	Active Ingredient	Application
<u>Alfalfa</u>			<u>Peas</u>		
Assail	Acetamiprid	Ground application	Cruiser Maxx Pulses	Thiamethoxam	Seed Treatment
<u>Beans</u>			Cruiser 5FS	Thiamethoxam	Farm or Commercial application
Cruiser Maxx beans	Thiamethoxam	Seed Treatment	Stress Shield 600	Imidacloprid	Seed Treatment
Cruiser 5FS	Thiamethoxam	Commercial seed treatment	<u>Potatoes</u>		
Stress Shield 600	Imidacloprid	Seed Treatment	Actara 240SC	Thiamethoxam	Seed Treatment
<u>Canola</u>			Actara 25WG	Thiamethoxam	Air or Ground application
Helix Vibrance + Lumiderm	Thiamethoxam	Seed Treatment	Admire 240 F	Imidacloprid	Ground application
Prosper EverGol + Lumiderm	Clothianidin	Seed Treatment	Alias 240 SC	Imidacloprid	Ground application
Helix Vibrance	Thiamethoxam	Seed Treatment	Grapple	Imidacloprid	Ground application
Prosper EverGol		Seed Treatment	Admire SPT	Imidacloprid	Seed Treatment
Gaucho Canola System	Imidacloprid	Seed Treatment	Assail	Acetamiprid	Ground application
Gaucho Platinum	Imidacloprid	Seed Treatment	Clutch	Clothianidin	Air or Ground application
Sombrero	Imidacloprid	Seed Treatment	Concept	Clothianidin	Air or Ground application
<u>Chickpeas</u>			Cruiser Maxx Potato Extreme	Thiamethoxam	Seed Treatment
Cruiser Maxx Pulses	Thiamethoxam	Seed Treatment	Minecto Duo	Clothianidin	Ground application
Cruiser 5FS	Thiamethoxam	Commercial seed treatment	Titan	Clothianidin	Seed Potatoes
Stress Shield 600	Imidacloprid	Seed Treatment	<u>Rye</u>		
<u>Corn</u>			Cruiser Maxx Vibrance	Thiamethoxam	Seed Treatment
Cruiser Extreme 25	Thiamethoxam	Seed Treatment	Cruiser 5FS	Thiamethoxam	Seed Treatment
Cruiser 5FS	Thiamethoxam	Commercial seed treatment	<u>Sunflower</u>		
Poncho 250	Imidacloprid	Seed Treatment	Cruiser Maxx Sunflower	Thiamethoxam	Seed Treatment
Sombrero	Imidacloprid	Seed Treatment	<u>Sovbean</u>		
<u>Fababean</u>			Cruiser Maxx Vibrance Beans	Thiamethoxam	Seed Treatment
Cruiser Maxx Pulses	Thiamethoxam	Seed Treatment	Cruiser 5FS	Thiamethoxam	Commercial seed treatment
Cruiser 5FS	Thiamethoxam	Farm or Commercial application	Stress Shiled 600	Imidacloprid	Seed Treatment
Stress Shield 600	Imidacloprid	Seed Treatment	Alias 240 SC	Imidacloprid	Seed treatment
<u>Lentil</u>			Concept		Ground application
Cruiser Maxx Pulses	Thiamethoxam	Seed Treatment	<u>Small grain Cereal (Wheat, barley Oats)</u>		
Stress Shield 600	Imidacloprid	Seed Treatment	Cruiser Maxx Vibrance	Thiamethoxam	Seed Treatment
Cruiser 5FS	Thiamethoxam	Farm or Commercial application	Cruiser 5FS (N)	Thiamethoxam	Farm or Commercial application
<u>Mustard</u>			Alias 240 SC	Imidacloprid	Seed Treatment
Helix Vibrance	Thiamethoxam	Seed Treatment	Raxil ProShield	Imidacloprid	A co-pack of Raxil Pro and StressShield
Helix Vibrance + Lumiderm	Thiamethoxam	Seed Treatment	Raxil WW	Imidacloprid	A combination of Raxil MD and Stress Shield.
Prosper	Clothianidin	Seed Treatment			
Gaucho Canola System	Imidacloprid	Seed Treatment			
Gaucho Platinum	Imidacloprid	Seed Treatment			
Sombrero	Imidacloprid	Seed Treatment			

14 **SI Table 4:** Oral LC₅₀ of active ingredient neonicotinoids (NIs) for worker honey bee *Apis*
 15 *Mellifera*.

	Laurino et al 2013	EU Comission 2004	Suchail 2000	Kamel 2010	Bonmat in 2015	Nauen et al 2001	Schmuck et al 2001	Suchail et al 2001	DEFRA 2007	DEFRA 2009	Iwasa et al 2004	Decourtye and Devillers (2010)	Elbert et al 2000
ng Bee⁻¹ Oral Exposure													
Neonicotinod													
Acetamiprid		14530			7100				7500		7070	14500	
clothianidin	2.7 (1.7-3.7)			3.5	2.5						22	44	
Imidacloprid			57		3.7	41-81	40-60	49	102	490			
Thiacloprid			14600		12600				35000		14600	38800	24200
Thiamethoxam	4.4 (3.6-5.3)				5.0				3.5	3.9	30	24	
Nitenpyram											138	23	
Imidacloprid Metabolite													
I-Olefin			28			36							
I-5-Hydroxy			258			49							
I-Urea			>1000			99500							
I-Desnitro Olefin			>1000										
I-Desnitro HCL			>1000										
6-Chloronicotinic Acid				>1000		1215000							

SI Table 4: A short summary of the oral LC₅₀ for worker honey bee (*Apis mellifera*) concentrations shown are typically for 24-48 h exposures in controlled conditions. Each value here represents a variety of methods and exposure processes reflecting the wide variability of bee studies.

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