

Background

- Neonicotinoids are one of the most commonly used insecticides in the world
- Typically applied as a seed dressing
- Most common neonicotinoids in Ontario are clothianidin and thiamethoxam
- Possible links between neonicotinoid use and the decline in pollinator and aquatic invertebrate populations^{4,5,6}
- Ontario legislation (2015) aims for an 80% reduction of the number of acres planted with neonicotinoid-treated maize and soybean crops by 2017⁷

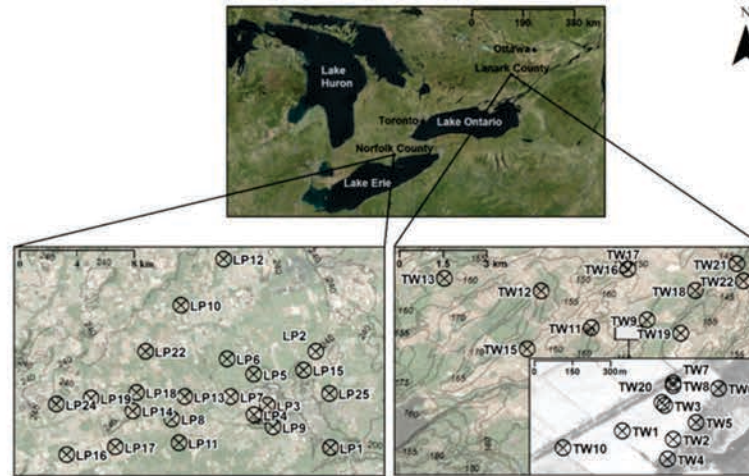
Objectives and Methodology

This research aims to fill the following knowledge gaps:

- Investigate the presence and fate of neonicotinoids in Ontario groundwater
- Compare results in distinct hydrogeologic settings

This involved:

- Five seasonal sampling rounds of groundwater monitoring wells between 2016 and 2017
- Crop survey
- Numerical and analytical modelling using Hydrus 1D, the Ogata-Banks solution, and the Tang solution

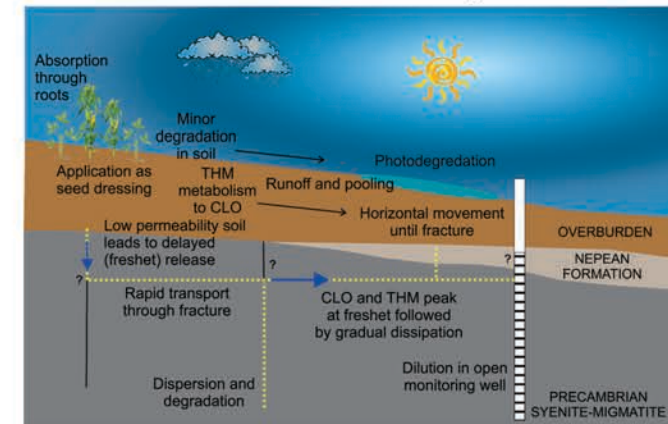


Location of the two sampling sites within southern Ontario. The monitoring wells in Norfolk and Lanark County are represented by "LP" and "TW", respectively.

Detections of clothianidin, imidacloprid, and thiamethoxam above the level of quantitation are shown. In total, 226 groundwater samples were analyzed for neonicotinoids at the University of Guelph Ridgetown Campus using LC-ESI(+)-MS/MS Analysis.

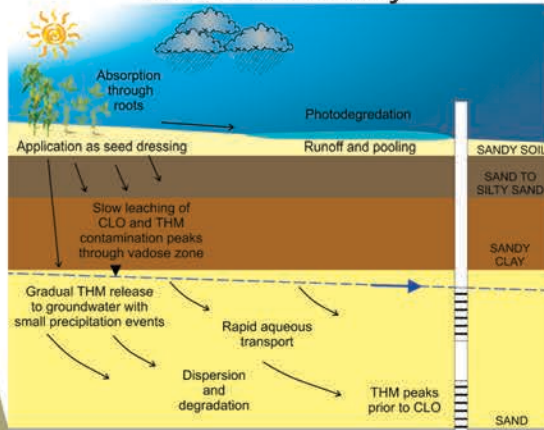
Sampling Date	Clothianidin (µg/L)	Thiamethoxam (µg/L)
April 2016	TW17 (0.095)	TW17 (0.46)
July 2016	---	TW17 (0.061)
August 2016	L2D (1.68)	---
	LP8D (2.09)	---
	LP11D (1.67)	---
November 2016	---	---
April 2017	---	TW17 (0.42)
Detection Frequency (%)	2.2	1.3

Lanark County



Conceptual diagram of the transport of clothianidin (CLO) and thiamethoxam (THM) through the crystalline bedrock aquifer in Lanark County

Norfolk County



Conceptual diagram of the transport of clothianidin (CLO) and thiamethoxam (THM) through the quaternary aquifer in Norfolk County



Groundwater sampling in Norfolk County (April, 2016)



Soil sampling in Lanark County (July, 2016)

Summary

- Thiamethoxam spring peak likely influenced by low permeability overburden
- Mathematical modelling revealed that clothianidin and thiamethoxam can peak in groundwater in the late summer into early autumn months
- All neonicotinoid concentrations in groundwater are at least an order of magnitude lower than what is considered harmful to honey bees and aquatic invertebrates
- Subsequent studies should focus on the presence and fate of any insecticides in groundwater that will be used in lieu of neonicotinoids

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⁴ Goulson (2013)

⁵ Morrissey et al. (2015)

⁶ Woodcock et al. (2017)

⁷ Government of Ontario (2009)