Neonicotinoids and Bee Incidences in Ontario

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Ontario

Who I am

- 13 years as the Field Crop Entomologist - Program Lead with OMAF
- M.Sc. Entomology – U of Guelph
- B.Sc. (Agriculture) Honours – Environmental Biology (major Environmental Impact) – U of Guelph
- research and extension focused on soil insect pests and invasive species that impact field crops
- currently one of the lead investigators into the routes of exposure to bees during corn planting
- member of the Ontario Bee Health Working Group
- resident of London

What are Neonicotinoids?

- chemical group of insecticides that are similar to nicotine
- registered in Ontario in 2001 to replace older chemistries like organophosphates and carbamates
  - low mammalian toxicity (eg. registered for flea control tablets/collars for cats and dogs), reducing risk to grower exposure
- Highly toxic to some insects, especially bees
  - Pyrethroid: dimethoate (Cygon) oral LD50 is 0.15 ug/bee
  - Neonic: clothianidin (Poncho) oral LD50 is 0.0038 ug/bee

Neonicotinoid Metabolites

Seed Treatments

- Imidacloprid – Gaucho and Stress Shield
- Clothianidin – Poncho - rapidly breaks down to thiamethoxam
- Thiamethoxam – Cruiser

- Also used as foliar applications, soil drench, tree injection under different product names, mostly on hort crops

- Acute poisonings linked to seed treatments during planting of corn and soybeans

History of Neonicotinoids in Field Crops

- First registered on corn in 2001, now registered on all crops in Ontario (include hort crops) except for forages
- Current Usage:

Corn	99%
Soybeans	65%
Cereals	25-33%
Dry Beans	95%
Canola	100%

- Lower a.i. rate per acre as a seed treatment, less labour intensive, lower grower exposure and in some cases, the most effective (and only) measure of control


Wireworm
Untreated vs Treated
Clothianidin
Rodney, Ontario
June 22/02

UNIVERSITY of GUELPH
RIDGETOWN CAMPUS
CHANGING LIVES IMPROVING LIFE

On-Farm Insecticide Trials 2002 and 2003

-- Wireworm Control –

- In soil for up to 6 yrs, sand & silt soils only
- 38 replicates across s. Ontario
  - Low infestions = 9 bu/ac yield loss
  - Mod infestations = 13 bu/ac yield loss
  - High infestations = 20 bu/ac yield loss

Hooker and Schaafsma, 2003

OSCIA/OMAF and MRA Grower Strip Trials

Previous Crop	2004 OSCIA	2004 Industry Plots	2005 OSCIA
Wheat w/Red Clover	4.2 bu/A (6)		
Wheat	0.6 bu/A (16)	3.1 bu/A (52)	4.1 bu/A (24)
Soybeans	0.9 bu/A (36)	2.3 bu/A (46)	2.9 bu/A (31)
AVG.	**2.3 bu/A** (n=58)	**3.0 bu/A** (n=98)	**3.3 bu/A** (n=55)

Gilles Quesnel, OMAF and MRA, Crop Advances 2005

Alternatives to Neonics

- Force 3G (pyrethroid) granular insecticide for wireworm and grubs in corn however new planters would need to be modified ($15,000 for 12 row planter)
- No alternatives registered for below ground pests in other field crops
- Need research data and new registrations = need time
  - Canada requires data on both crop and pest
  - Some foliar insecticides (pyrethroids or organophosphates) available for above ground early season pests
  - May require multiple sprays that we were not doing before
  - Impact to non-targets (including bees) due to broadcast sprays of older chemistries
  - Resistance management concerns due to lack of different chemical families to rotate with

Ontario 2012 Bee Cases

- 242 incidences of acute pesticide poisoning of honey bee colonies during spring of 2012
- Most were reported in association with corn planting time
- Cases were investigated by MOE, PMRA and OMAF and MRA
- A high proportion of dead bees collected for residue analysis (70%) revealed the presence of an insecticide used on treated corn seed.
- Other bee health issues ruled out
- No cases due to any off-label use

2013 Incidences

- Over 150 incidences across Ontario, though most were in Southern Ontario
- Not only associated with corn planting but also soybean planting
- Preliminary results provided by PMRA to the bee health working group would indicate that the majority of the dead bees collected once again indicates neonicotinoid seed treatment present
- Other incidences in Quebec and some US states

Bee Health

- Many factors affect bee health
- Varroa mites are the number one concern. Use miticides to deal with this issue
- Colony Collapse Disorder (CCD) major cause of bee loss worldwide is a combination of potential issues:
  - Varroa mites
  - pathogens/diseases like Nosema
  - pesticides including miticides used for Varroa
  - environmental stressors (weather, lack of diverse forage crops etc)
  - hive management (nutrition etc)
- Disease/pathogens etc. were not found to be the cause of the bee kills during corn/soy planting in 2012 &13

How does a bee come in contact with a seed treatment? The likely route is through negative vacuum planters which use air to move seed through the planter for proper positioning into the seed bed. These planters require the use of a lubricant to help the seed flow through it. Research has found that lubricant (talc or graphite) to be abrasive and rubs the seed treatment off of the seed. The planter then exhausts that contaminated dust into the air, possibly landing on the nearby vegetation.

Results from Purdue Study: Planter exhaust (used talc)

- Extremely high concentrations of seed coatings found in used talc

Seed type	Thiamethoxam	Clothianidin	Metalaxyl	Trifloxystrobin
Unused talc	ND	ND	ND	ND
Treated seed 1	735, 000 ppb	3,400,000 ppb	116, 000 ppb	66,000 ppb
Treated seed 2	68,000 ppb	10,000,000 ppb	92,000 ppb	50,000 ppb
Treated seed 3	13,240,000 ppb	4,900,000 ppb	263,000 ppb	503,000 ppb
Treated seed 4	70,000 ppb	15,030,000* ppb	131,000 ppb	313,000 ppb
Untreated corn seed	ND	*47,000 ppb*	ND	ND

Krupke et al. 2012- http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0029268

Work from Krupke et al 2012 – tested the residue levels in the spent talc coming from the planters. Found extremely high levels of neonics which are far above the lethal contact and oral doses. This indicates that the planters are the likely route of exposure and that measures need to be taken at the planter to reduce this contaminated dust.

Research study conducted in 2013 in Ontario to investigate the possible routes of exposure. Baute, Schaafsma and Scott-Dupree. Samples were taken during planting including exhaust dust from planter manifold, dust blowing from field during planting, soil samples before and immediately after planting, flowers downwind after planting and pollen and water samples taken for up to 6 weeks after planting. Report due on October 31st, 2013.

Neonic and Bee Exposure: Two Main Issues

Contaminated Dust from Planter (Acute Risk)	Total Insecticide Loading (Chronic risk)
Found to be linked to incidences	*Exposure via water, soil and/or pollen*
Fugitive dust from vacuum planters	*Exposure not just during spring*
Impacts of polymers and lubricants	*Multiple exposures from many crops*
Farmer practices	
Environmental conditions	
Opportunity to make a direct, positive influence on bee kill incidences by managing the contaminated dust coming from planters at planting.	**More research needed to understand what the level of exposure is and whether that levels has an effect on bees. Research up to date have found no effects at low levels but more studies needed.**

Results from Purdue Study: Soil and dandelions

- Found in all soil, including 2 years after application
- Also found on all dandelions collected from near fields

Field history	Thiamethoxam (ppb)	Clothianidin (ppb)	Metolachlor (ppb)	Atrazine (ppb)
Corn-corn	ND	6.3	5.9	52
Soy-soy (untreated)*	ND	9.6	11.1	7.8
Corn-soy	ND	4.9	6.1	8.5
Soy-corn	ND	2.1	ND	22
Dandelions: non-ag area	ND	ND	ND	ND
Dandelions: unplanted cornfields	1.15	3.75	84	622

Krupke et al 2012 took soil samples from various fields with different crop histories prior to planting. They found that neonics were present in all samples taken from agricultural land and are staying in the soil for much longer than expected. Even in fields where there were untreated soybeans for two years in a row.

Exposure via Soil and Water?

- Honey bees do not feed on soil but soil can blow onto neighbouring vegetation or water source.
- What are the levels on vegetation and in water and are they high enough to effect bees?
- Some other bees are ground nesters so they could be exposed to soil residues
- Water and soil taken near the bee yards by PMRA were found to contain neonics at levels below detection or well below those that likely cause effects to bees

Ontario Bee Health Working Group

- Mandate is to develop recommendations to the province on how to mitigate risk of bee exposure to neonicotinoids during corn and soybean planting
- Includes members from:
  - Ontario Ministry of Agriculture and Food
  - Ontario Ministry of Environment
  - Federal Pest Management Regulatory Agency
  - Ontario Grain Farmers of Ontario
  - Ontario Beekeepers' Association
  - Bee Researchers from the University of Guelph
  - Canadian Seed Trade Association
  - Ontario Federation of Agriculture
  - Crop Life Canada
  - Bayer CropScience
  - Syngenta Canada

Potential Recommendations Being Considered

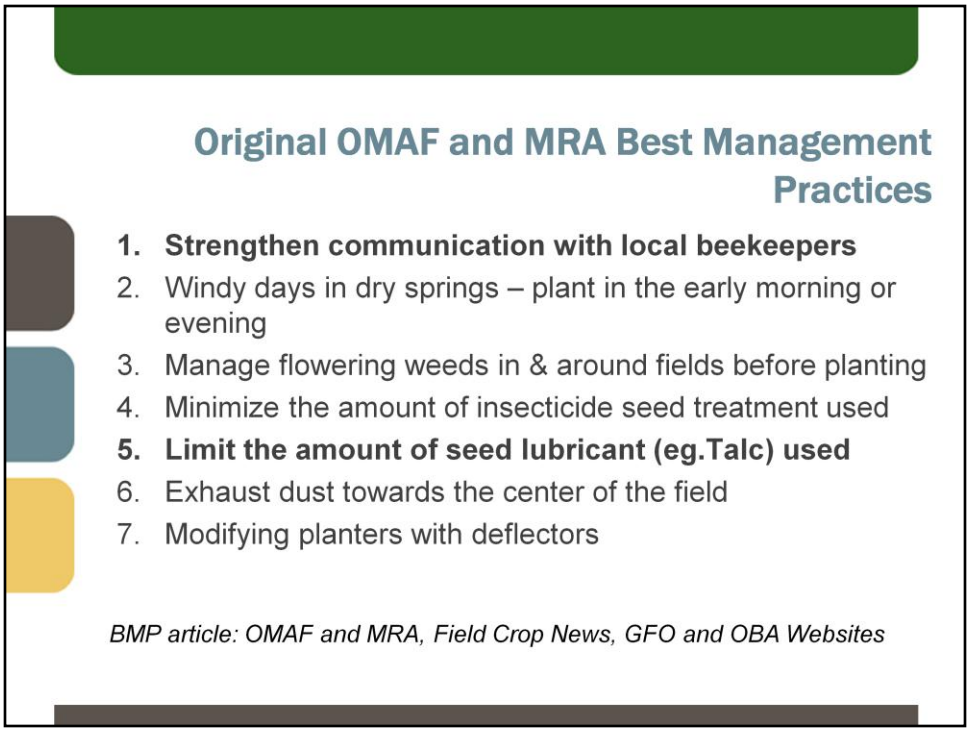
- Strengthen Best Management Practices (find a balance between use and reduced exposure) for growers and beekeepers
- Promote IPM including funding new research on soil insect IPM
- Promote the availability and use of fungicide only seed for low risk growers for 2014
- Develop reduced risk insecticides
- Promote the use of better dust reducing lubricant
- Include BMPs in Ontario Pesticide Safety Course
- Provincial Ban of Neonicotinoid Use (on corn and soybeans?)

Availability of Fungicide Only Seed

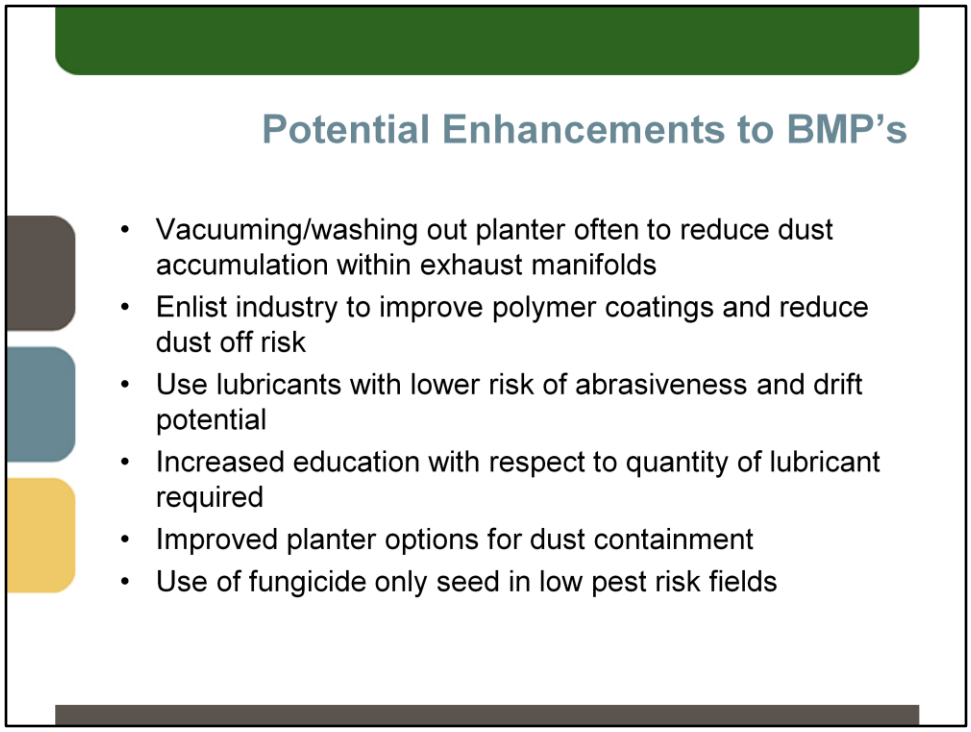
- Grain Farmers of Ontario requested the Canadian Seed Trade Association to provide fungicide only options
- All corn companies have now promised to provide fungicide options for the 2014 but early ordering is required (as early as Oct 15, 2013)
- Significant extension campaign will be launched in the next few days to encourage those growers at low risk to consider using fungicide only seed

Significant Promotion of Integrated Pest Management

- Use fungicide only seed where pest risk is low
- Educate growers on what their insect risks are and how to scout for them
- Some research needed to strengthen current IPM recommendations
- Growers at risk of pest issues still need protection by an insecticide



The original BMPs were likely difficult to implement in their entirety and were not established earlier enough in 2013. Only two components were likely feasible at the time. Now components of the BMPs are available to use in 2014.



These are potential additional measures that can help to strengthen the BMPs and reduce the risk of dust exposure at planting. Research will continue to help strengthen these even further.

Provincial Ban Ramifications

- Serious impact to seed importation from US and Western Canada
- Could impact seed selection/availability for growers
- Serious impact to exportation markets of Ontario seed corn and food grade soybean seed due to quarantined diseases (seed corn and food grade beans must be protected from insect pests that vector viruses).
- Could lose the seed corn industry that is left in Canada (southwestern Ontario)
- Currently no below ground alternatives for soil pests except for wireworms and grubs in corn

Provincial Ban Ramifications (cont'd)

- Some growers would suffer serious crop losses (esp. canola) and growers with grub issues
- Serious implications to crops that do not have alternatives to protect crop including horticultural crops
- Impacts of increased use of foliar insecticides in place of these seed treatments for above ground pests
- Need time to get alternatives registered and implemented
- How/Who would enforce this?
- PMRA is committed to making a science based decision

Gaps in Neonic Research and Knowledge

- Independent research on clothianidin and thiamethoxam
- Most research done in lab on caged adult worker with unrealistically high doses. Need work on field realistic doses
- Sublethal experiments that show no effect were not well designed to come to that conclusion
- More work done on chronic/sublethal effects, taking longer term observations (full season and into winter)
- Other pollinators - almost all work done on honey bees
- More work done on overall colony health and effects
- Work on synergistic effects of other pesticides used on crops and at hive
- More work on field and planter exposure and how to further mitigate the risk

Questions/Discussion

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