Neonicotinoid Insecticides and Bees

A retrospective analysis of research, legislation, and options for the future

What We Know

Wild and managed pollinators have an intrinsic role in the process of agriculture and are vital for nearly 80% of all flowering plant species

Managed bee populations have been declining, 67.2% of respondents to the ninth annual national survey of honey bee colony losses reporting a 29% post winter die off, with 18.7% being the average accepted winter mortality

There are a number of factors which can perturb bee population: Parasites, pathogens, lack of genetic diversity, habitat loss, weather and, with a high degree of scientific consensus, neonicotinoids

Neonicotinoids were introduced to the United States in 1994, and since have become the most widely used class of insecticide world wide

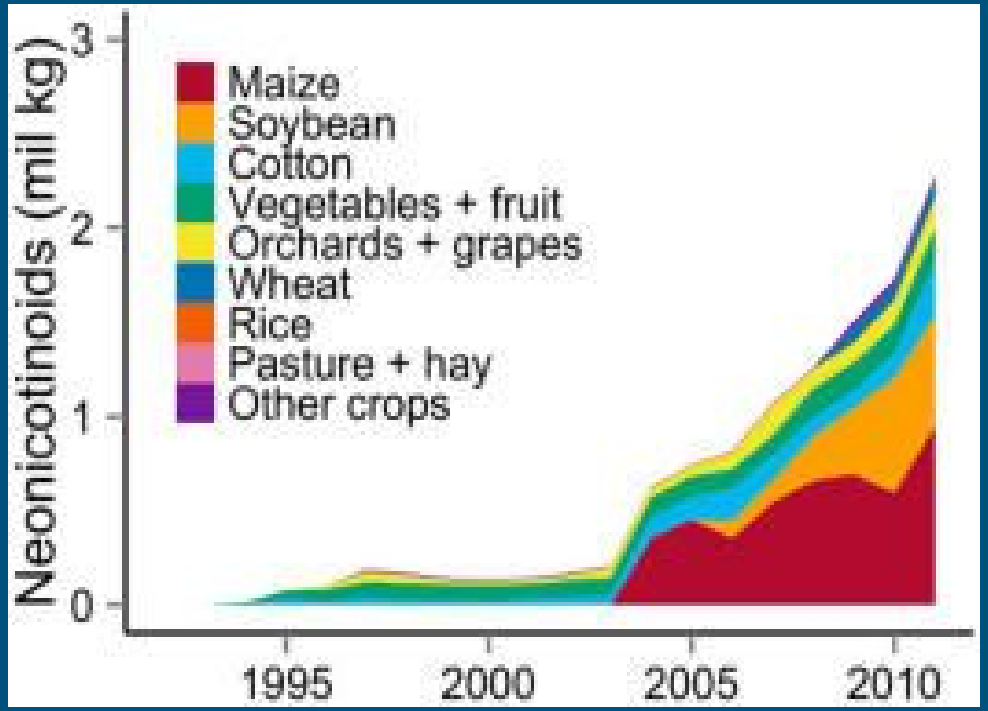
By market share: Imidacloprid (41.5%), Thiamethoxam, Clothianidin, Acetamiprid

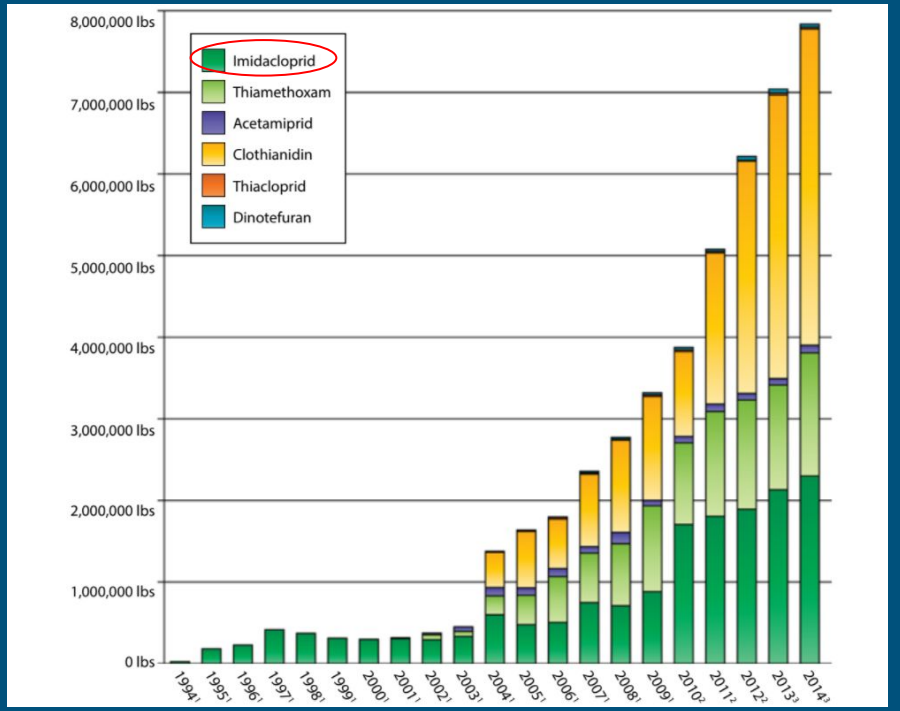
The use of seeds treated with neonicotinoids is not recorded in the survey conducted by the National Agricultural Statistics Service, 87% of maize hectares had Neonicotinoid Seed Treatments with 31% of soybean hectares receiving seed treatment (2015) (U.S. Geological Survey Pesticide National Synthesis Project)

60% of Neonicotinoid applications is soil or seed treatment

They can also be sprayed, put in drip or drench irrigation systems, along with other methods

Neonicotinoid Use in The United States





Neonicotinoids and Homing Capabilities

Henry, Beguin, Requir *et al.*, (2012) *Science*.

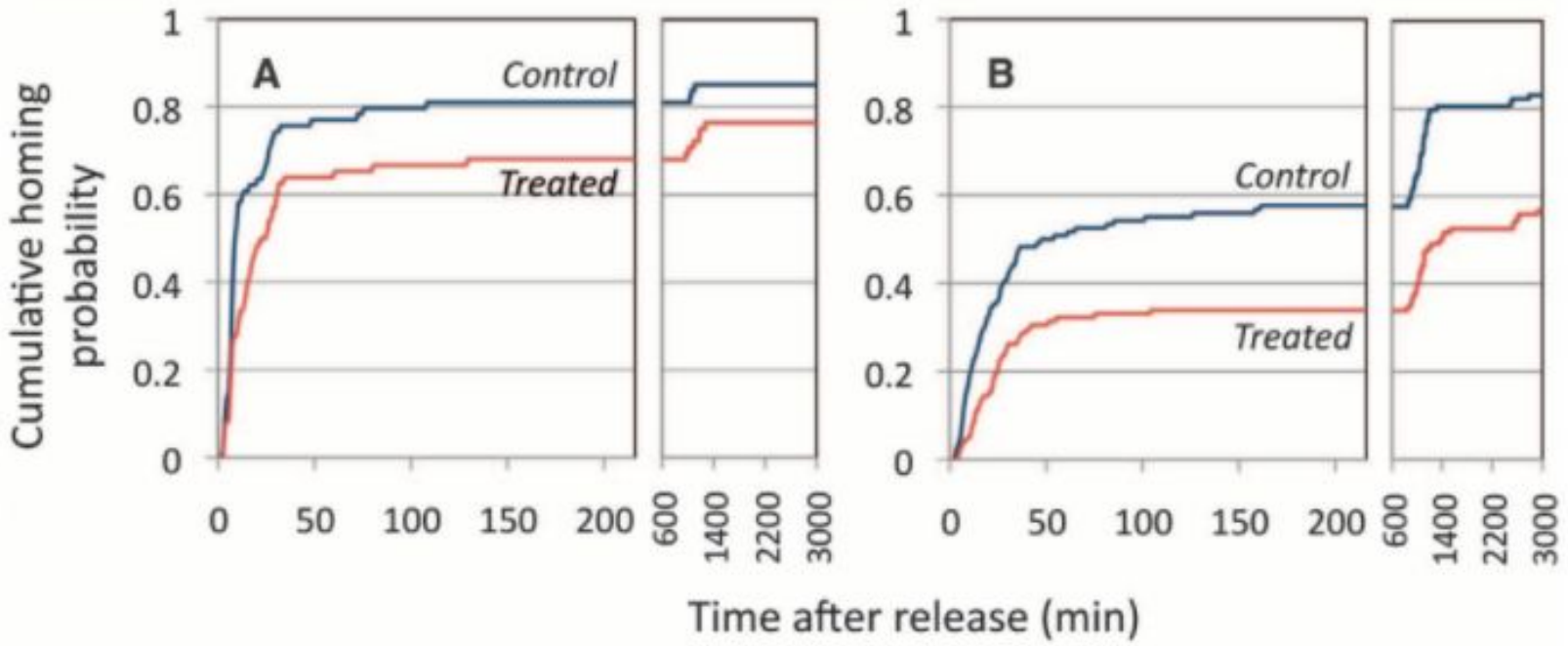
Non lethal exposure to thiamethoxam created quantitative impairment of bee homing abilities

Bees were tagged with RFID chips to track if they entered the hive

Non control group was fed a non lethal diet containing thiamethoxam at doses mimicking exposure from anthropogenic sources, control group were fed an untreated sucrose solution

Trials were conducted in different landscapes including trials where the bees were familiar with the foraging sites, and new foraging sites

Treated vs. Non treated Bees Foraging Familiar and New Sites



Science Magazine April 2012

Neonicotinoid Effect on Colony Growth

Whitehorn, O'Connor, Wackers *et al.*, 2012 *Science*.

75 bumblebee colonies divided in 3 groups: Control, low exposure, high exposure

Imidacloprid dose for high was double the low, both realistic exposure levels

Cumulative colony weight increased initially in all groups, significantly for control

Empty pupal cells was 19% (low) and 33% (high) less compared to control group

Control: 13.72 queens, Low exposure: 2 queens, High exposure: 1.4 queens

Change in colony size disproportionately affects the colonies' ability to produce queen bees

Neonicotinoids and Pollination

Stanely, Garrat, Wickens *et al.*, 2016 *Nature*.

24 colonies (8 per group): control, 2.4 ppb thiamethoxam, 10 ppb thiamethoxam

Bees were brought to a field and allowed access to different apple varieties

10 ppb group visited less apple flowers than control and 2.4 ppb groups

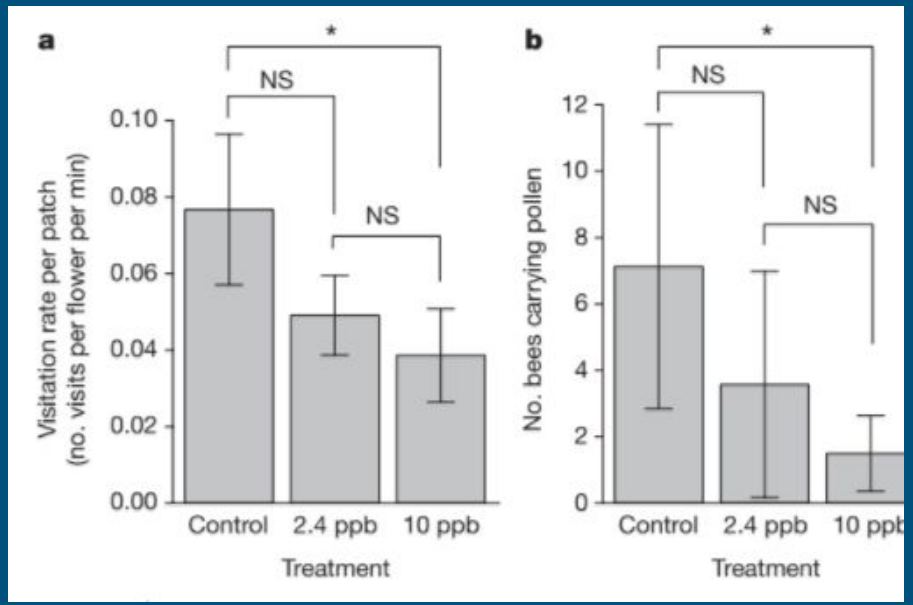
10 ppb group had less bees per foraging trip return to hive carrying pollen

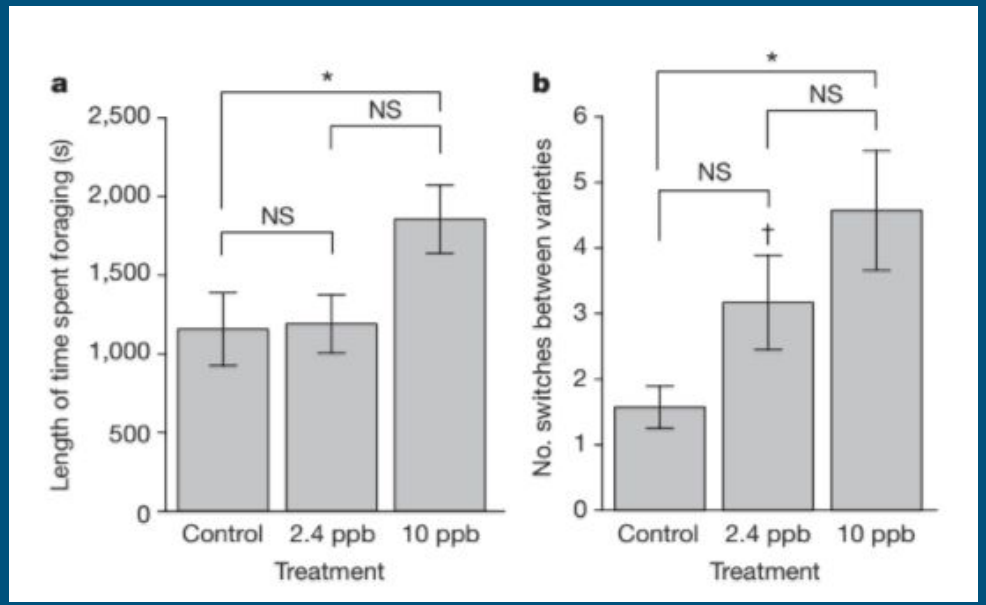
10 ppb group spent the most time foraging and most switches between varieties

Trees pollinated by 2.4 ppb group aborted more fruit than the control group

Fruit of trees pollinated by 10 ppm group had significantly less seeds

Foraging Activity Based on Exposure Rates





Nature December 2016

Current Global Response

18 states have enacted legislation to assess and benefit pollinator health, along with provinces of Canada, and the EU

Most of the passed legislation revolved around research, pesticide bans/regulations, pollinator habitat protection/expansion, public/ industry awareness, and beekeeping

More than 20 states considering taking action to protect pollinators

Neonicotinoid Specific Action

Minnesota (2016)-executive order 16-07 Directing Steps to Reverse Pollinator Decline and Restore Pollinator Health in Minnesota

- Requires verification of need prior to the use of neonicotinoid pesticides
- A review of pesticide product labels and implement restrictions as appropriate to protect pollinators
- Increased inspection and enforcement of label requirements for pesticides acutely toxic to pollinators
- Continue to develop and promote best management practices designed to protect pollinators

Neonicotinoid Specific Legislation

Maryland (2016) Enacted under Article II, Section 17(c) of the Maryland Constitution - Chapter 661

- Neonicotinoid pesticide is prohibited from being sold in the state after January 1, 2018, except by existing restricted use chemical sellers
- Neonicotinoid application after January 1, 2018 is prohibited unless the person is a certified applicator
- Effectively a consumer use ban

Neonicotinoid Specific Legislation

- California (AB 1789-2014) requires the Department of Pesticide Regulation to re-evaluate the effect of neonicotinoids on pollinator health by July 1, 2018 and to adopt controls in accord of their findings by 2020

California-Senate Bill 602: Pesticides: neonicotinoids: Labeling (2017-2018)

- July, 1, 2018 all seeds and plants treated with neonicotinoids sold at retail establishments must be labeled “STATE OF CALIFORNIA SAFETY WARNING: MAY HARM BEES” & a logo
- Treatment includes foliar, granular , and seed application of neonicotinoids

Neonicotinoid Specific Legislation

Connecticut-Public Act 16-17 (An Act Concerning Pollinator Health 2016)

- Commissioner of Agriculture, with Connecticut Agricultural Experiment Station and Department of Energy and Environmental Protection, developed best practices for minimizing the airborne liberation of neonicotinoid insecticide dust from treated seeds
  http://www.ct.gov/caes/lib/caes/documents/publications/pollinators/best_management_practices_for_handling_seeds_treated_with_neonicotinoid_insecticides.pdf
- No person shall apply a neonicotinoid to linden or basswood trees to prevent “bee kills”
- January 1, 2018 neonicotinoids for treating plants become restricted use
- No applying neonicotinoids to plants in bloom
- Continued research of neonicotinoids and best use for pollinator health

Neonicotinoid Specific Legislation

Ontario- Amendment to Pesticide Act R.S.O, 1990 (2015)

- Use of corn and soybean seeds treated with imidacloprid, thiamethoxam and clothianidin is restricted to need based on land surveying
- IPM training required to work with class 12 pesticides (neonicotinoids), each certified person may overlook 7 other people
- Pest assessment reports are needed to purchase treated seeds
- Dust reducing seed flow lubricants must be used while planting along with modified equipment
- Ontario government is continuing to monitor the impact of treated seeds

Neonicotinoid Specific Legislation

Vancouver- Health By-Law No. 9535 section 2.9 Ban on Pesticides(2016)

- Persons may not apply, or allow the application, of neonicotinoids
- Also banned is the use of neonicotinoids or any registered pesticide to directly or indirectly control, destroy, attract, or repel a pest, being animal, plant, or other organism that is directly or indirectly injurious, noxious, or troublesome, or an injurious, noxious, or troublesome condition or organic function of an animal, plant, or other organism, or to mitigate or prevent any injurious, noxious, or troublesome effects of a pest.

Neonicotinoid Specific Legislation

European Union: Commission Implementing Regulation No 485/2013

- Bans neonicotinoid treated seeds for many crops, unless in a greenhouse
- Seed coating shall only be applied in a professional seed coating facility
- Proper seed drilling technology must be used while planting
- Foliar treatment of neonicotinoids is banned on bee attractive crops
- Seed, soil and foliar treatment is banned on certain crops
- Conditions of use involve risk mitigation measures (proximity to bees, potential guttation exposure, potential exposure to dust)

Bees and Massachusetts

- 45% of agricultural commodities rely on managed bees for pollination (Massachusetts Pollinator Protection Plan)
- Massachusetts experienced highest colony loss in New England (2015/16)
- Wild and managed pollinators are necessary for cranberries and often multiple pollination visits are needed in a single season (Massachusetts Cranberries)
- Cape Cod Cranberry Grower's Association creates 1.4 billion in economic activity and 6,900 jobs
- In 10 years renting costs doubled, pollinating a barrel is 100$, 1.9 million barrels of cranberries are produced in Massachusetts per year

Options for Massachusetts

Create a neonicotinoid focused best use guide

Make all neonicotinoids restricted use chemicals

Restrict the use and sale of neonicotinoid treated corn seeds

Require specific planting methods for treated seed

Require proof of need for the use of neonicotinoids

Continue research on neonicotinoids and pollinator health

Restrict use in vulnerable areas and on linden or basswood trees

Educate the public on neonicotinoids and pollinator health