

Bee Industry – Threats and Challenges

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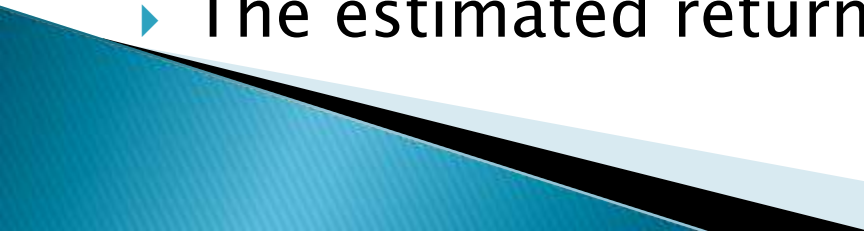


Bee Industry


*“I may be small but
I play a big role in your life”.*

Jonathan Bailey
National Water
Research Institute
(NWRI)
Saskatoon, SK,
Canada

Bee Industry

- ▶ Honey production is a high income generating activity.
 - ▶ All hive products, including bee pollen, beeswax, queen bees and royal jelly, command premium prices.
 - ▶ Large accarage is not required and the beekeeper need not own land, as apiaries are easily moveable.
 - ▶ Small beekeeping operations – up to 200 hives are not labour intensive and allow for other income generating activities.
 - ▶ The estimated return on investment is 23%.
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Bee Industry

- ▶ Currently Jamaica's annual honey production is estimated at 1,000,000 kg or 183,722 gallons at US\$20.45 /gallon with an annual income of US\$3.76 million.
 - ▶ The majority of honey produced is consumed locally ; only a small percentage is exported.
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Bee Industry

- ▶ Diseases of the honey bees
- ▶ Pests and Parasites:
- ▶ ***Varroa* mites** (*Varroa destructor* and *Varroa jacobsoni*) feed on the bodily fluids of adult, pupal and larval bees. *Varroa* mites have led to the virtual elimination of feral bee colonies in many areas, and are a major problem for kept bees in apiaries.
- ▶ **Acarine (Tracheal) mites** are small parasitic mites that infest the airways of the honey bee. Mature female acarine mites leave the bee's airway and climb out on a hair of the bee, where they wait until they can transfer to a young bee. Once on the new bee, they will move into the airways and begin laying eggs.


Bee Industry

- ▶ ***Nosema apis*** is a microsporidian that invades the intestinal tracts of adult bees and causes nosema disease, also known as nosemosis. *Nosema* infection is also associated with black queen cell virus. It is normally only a problem when the bees can not leave the hive to eliminate waste.
- ▶ **Small hive beetle** – *Aethina tumida* is a small, dark-colored beetle that lives in beehives.
- ▶ **Wax moths** – *Galleria mellonella* will not attack the bees directly, but feed on the wax used by the bees to build their honeycomb.
- ▶ **Tropilaelaps** – *Tropilaelaps clareae* and *T. mercedesae* are considered threats to honeybees. These mites have the potential to inflict serious damage to colonies due to their rapid reproduction inside the hive.

Bee Industry


- ▶ Bacterial diseases
- ▶ **American foulbrood (AFB)**, caused by the spore-forming *Paenibacillus larvae*¹, is the most widespread and destructive of the bee brood diseases. *P. larvae* is a rod-shaped bacterium. Larvae up to three days old become infected by ingesting spores present in their food.
- ▶ **European foulbrood (EFB)** is a bacterium that infects the midgut of the bee larvae and can survive several months on wax foundation. European foulbrood is considered less serious than American foulbrood.

Bee Industry

- ▶ **Fungal diseases**
 - ▶ **Chalkbrood** – is a fungal disease that infests the gut of the larva. The fungus will compete with the larva for food, ultimately causing it to starve.
 - ▶ **Stonebrood** is a fungal disease causes mummification of the brood of a honey bee colony.
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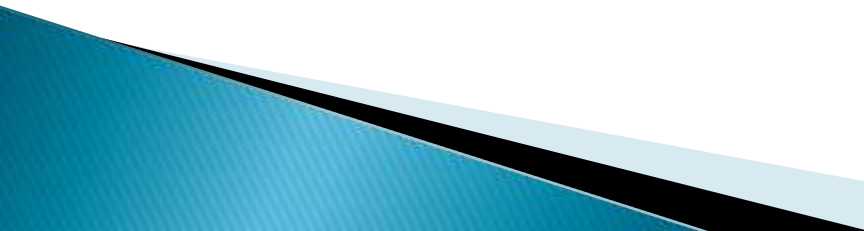
Bee Industry

Viral diseases

- ▶ Chronic paralysis virus
 - ▶ Acute bee paralysis virus
 - ▶ Israeli acute paralysis virus
 - ▶ Kashmir bee virus
 - ▶ Black queen cell virus
 - ▶ Cloudy wing virus
 - ▶ Sacbrood virus
 - ▶ Deformed wing virus
 - ▶ Kakugo virus
 - ▶ Invertebrate iridescent virus
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Neonicotinoids

Neonicotinoids

- ▶ are a class of neuro-active insecticides chemically similar to nicotine.
 - ▶ show reduced toxicity compared to previously used organophosphate and **carbamate** insecticides.
 - ▶ show much lower toxicity in mammals than insects, but some breakdown products are toxic.
 - ▶ include acetamiprid, **clothianidin**, **imidacloprid**, nitenpyram, nithiazine, thiacloprid and **thiamethoxam**.
 - ▶ **Imidacloprid** is currently the most widely used insecticide in the world.
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Neonicotinoids

- ▶ In 2013, the European Food Safety Authority stated that neonicotinoids pose an unacceptably high risk to bees and hence, the European Commission imposed a number of use restrictions on these insecticides which are suspected to be a contributing factor of **Bee Colony Collapse Disorder**.
- ▶ A study by Italian researchers, published by the **Proceedings of the National Academy of Sciences** of the United States of America on October 21, 2013, demonstrated that neonicotinoids disrupt the immune systems of bees, making them susceptible to viral infections to which the bees are normally resistant.


Neonicotinoids

- ▶ In March 2013, the American Bird Conservancy published a review of 200 studies on neonicotinoids and called for a ban on use of neonicotinoid as seed treatments because of their toxicity to birds, aquatic invertebrates, and other wildlife.
- ▶ Also in March 2013, the US EPA was sued by a coalition of beekeepers, as well as conservation and sustainable agriculture advocates who accused the agency of performing inadequate toxicity evaluations and allowing registration of the pesticides to stand on insufficient industry studies.


Neonicotinoids

- ▶ EU restricts the use of imidacloprid, clothianidin, and thiamethoxam for seed treatment, soil application (granules) and foliar treatment in crops attractive to bees.
 - ▶ Temporary suspensions of these three pesticides had been enacted in France, Germany, and Italy.
 - ▶ In Switzerland, where neonicotinoids were never used in alpine areas, a ban has also been implemented due to accidental poisonings of bee populations and the relatively low safety margin for other beneficial insects.
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Neonicotinoids

- ▶ A new study from Harvard School of Public Health (HSPH) revealed that two widely used neonicotinoids, imidacloprid and clothianidin significantly harm honey bee colonies over the winter. The study replicated a 2012 finding from the same research group that found a link between low doses of imidacloprid and Colony Collapse Disorder (CCD).
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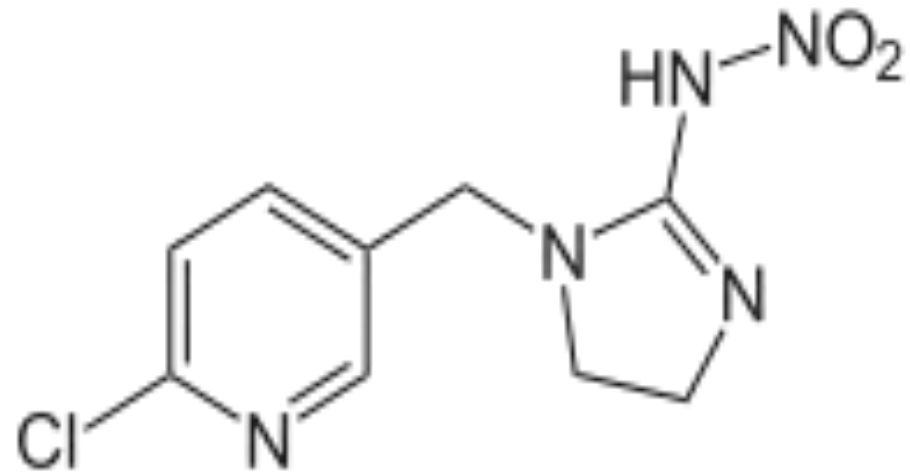
Neonicotinoids

- ▶ Neonicotinoids are widely-used in Australia, and as yet there is no mention of restrictions on their use. The Australian Pesticides and Veterinary Medicines Authority (APVMA) is currently undertaking a review into these insecticides and the potential risks to honey bee health. They will release a draft consultation report later this year containing their recommendations.
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Neonicotinoids

Imidacloprid is the most widely used insecticide in the world. It is a systemic insecticide which acts as an insect neurotoxin. Specifically, it causes a blockage in the neuronal pathway. This blockage leads to the accumulation of acetylcholine resulting in the insect's paralysis, and eventually death.

Because imidacloprid binds much more strongly to insect neuron receptors than to mammal neuron receptors, this insecticide is selectively more toxic to insects than mammals.



Imidacloprid

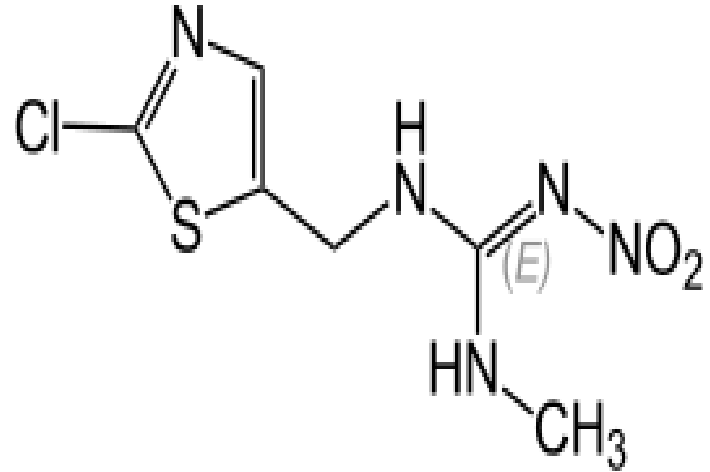
The contact acute LD_{50} is $0.024 \mu\text{g a.i./bee}$. The acute oral LD_{50} ranges from $0.005 \mu\text{g a.i./bee}$ to $0.07 \mu\text{g a.i./bee}$.

Neonicotinoids

Clothianidin

It is an insecticide developed by Takeda Chemical Industries and Bayer AG.

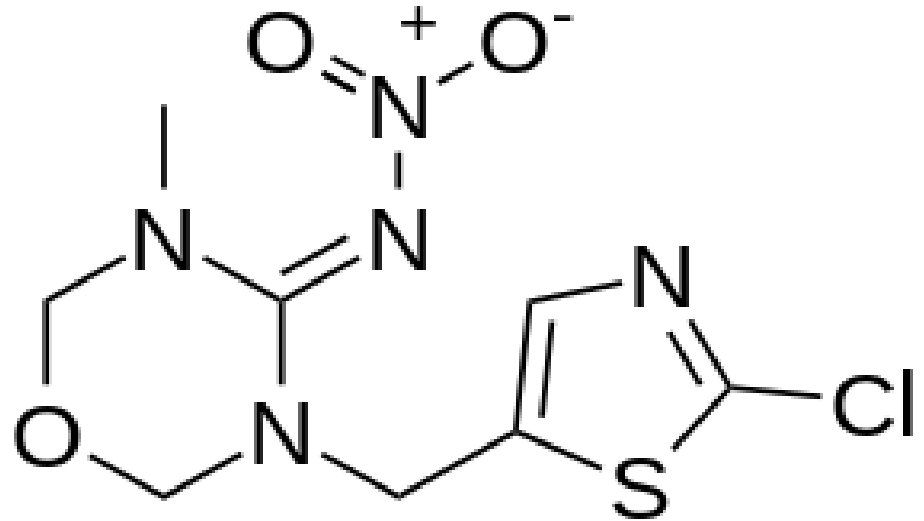
It is systemic, persistent and highly toxic to honey bees and also acts on the central nervous system of insects as an agonist of acetylcholine. Clothianidin is an alternative to organophosphate, carbamate, and pyrethroid pesticides. It poses lower risks to mammals, including humans, when compared to organophosphates and carbamates. It has helped prevent insect pests from building up resistance to organophosphate and pyrethroid pesticides.



Neonicotinoids


▶ Thiamethoxam

It is a **systemic** insecticide that is absorbed quickly by plants and transported to all parts of the plant, where it acts as a deterrent to insect feeding. It is active in the stomach of the insects, and also through direct contact. The compound interferes with information transfer between **nerve cells, making the insects become paralyzed**. A metabolite of thiamethoxam in soil is clothianidin.



Neonicotinoids

Data Gaps

- ▶ Analytical data on honey, bees and hives.
 - ▶ Environmental persistence in soil and subsequent uptake in rotational crops.
 - ▶ Availability in pollen and nectar.
 - ▶ Long-term effects on honey bees and other pollinators.
 - ▶ Effects on aerobic aquatic metabolism.
 - ▶ Ability to leach from treated seeds.
 - ▶ Acute toxicity to freshwater invertebrates.
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Pesticide Research Laboratory

- ▶ Established in 1995
- ▶ To train young science graduates for the demanding market in the field of analytical chemistry
- ▶ To do research in the field of Pesticide Science and produce M.Phils and Ph.D.s
- ▶ To offer analytical services to both private and public sectors
- ▶ To help governmental and non-governmental organizations in monitoring the extent of pesticide pollution in our ecosystem;
- ▶ To help PCA and agricultural sector to help in monitoring the pesticide residue in imported and locally grown produce.

Web Site : www.prljamaica.com



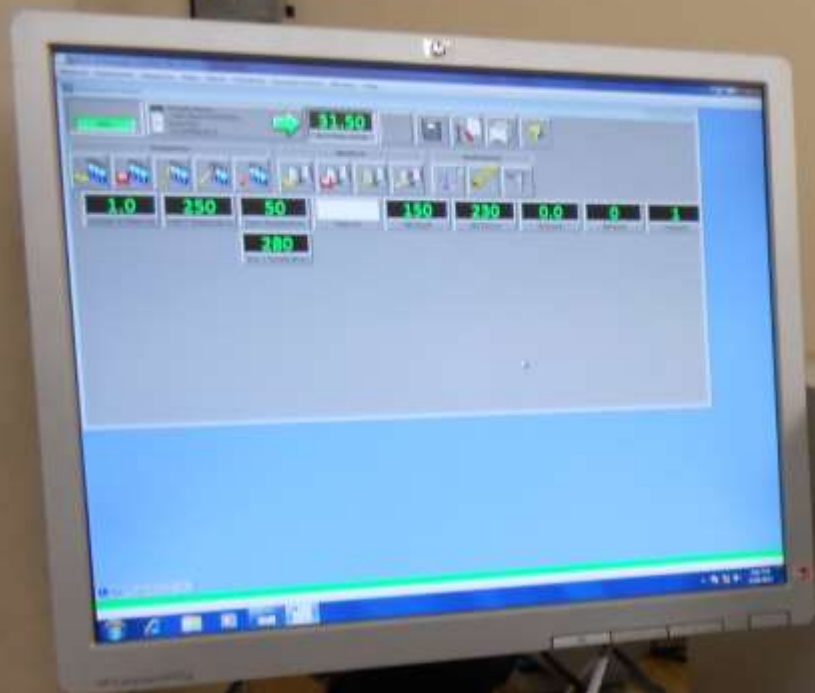




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