# Environment and Natural Resources Trust Fund
# 2014 Request for Proposals (RFP)

**DRAFT**
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## Project Title:

Protecting Bees by Understanding Systemic Insecticides

**Category:** F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

**Total Project Budget: $** 326,869

**Proposed Project Time Period for the Funding Requested:** 3 Years, July 2014 - June 2017

**Other Non-State Funds: $** 0


**Summary:**

Understand how native bee and honey bee colonies are impacted by systemic, neonicotinyl insecticides in pollen and nectar of plants growing in fields and landscapes.



**Name:** Vera Krischik

**Sponsoring Organization:** U of MN

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St. Paul MN 55116

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**Web Address** www.entomology.umn.edu/cues/pollinators/index.html


**Location**

**Region:** Statewide

**County Name:** Statewide

**City / Township:** St Paul

**MP:** 0613-2-224-proposa

**Budget:** 0613-2-224-bud

**Qual:** 0613-2-224-qualifi

**Map:** 0613-2-224-map-K

**Resolution:**

**List:**

_____ Funding Priorities _____ Multiple Benefits _____ Outcomes _____ Knowledge Base

_____ Extent of Impact _____ Innovation _____ Scientific/Tech Basis _____ Urgency

Capacity Readiness Leverage Employment TOTAL

**2014 LCCMR proposal**
**PROJECT TITLE: Protecting bees by understanding systemic insecticides**
**Project PI: Vera Krischik, University of Minnesota, Department of Entomology**

## I. PROJECT STATEMENT

Honey bees and bumblebees pollinate 1,000's of native plants and crops that produce the seeds, fruits, and nuts that we consume and bees contribute approximately $15 billion worth of crop yields. Since 2007 managed honey bee colony mortality was estimated as 30% and also, native North American bumblebee species are in decline. Bee loss is due to a combination of factors, such as insecticides, habitat loss, and disease. Neonicotinyl insecticides are systemic, which means they are applied to the soil or on seeds and move from the soil to roots, leaves, pollen, and nectar. In the U.S., one-third of all crop (143 million acres / total 442 million acres) are treated with over 2 million pounds of neonicotinyl insecticides. In 2009 in Minnesota, corn, soybeans, potatoes and canola used 46,766 pounds and landscapes used 6,000 pounds of imidacloprid and 19,347 pounds of clothianidin, two of the chemicals that are classified as neonicotinyl insecticides. The high use of neonicotinyl insecticides makes it probable that a foraging bee will eat nectar and pollen from a neonicotinyl-treated plant, which can reduce foraging, reduce colony health, and kill the bees. Bee loss will contribute to reduced pollination, seeds, and fruits of native plants and crops.

One of the major deficits in knowledge is how much neonicotinyl insecticide is found in pollen and nectar of neonicotinyl–treated plants, besides seed-treated crops. A canola seed is covered with 0.11 mg active imidacloprid (neonicotinyl chemical) that results in 7.6 ppb imidacloprid pollen. In urban landscapes, where bees forage for pollen and nectar, a soil surface application of imidacloprid can be applied to a native plant (300 mg) and basswood tree (67 g) from which basswood honey is produced We calculate that a 609,000 times greater amount of imidacloprid is applied to basswood trees compared to a canola seed. We do not know how much imidacloprid accumulates in pollen and nectar from these applications in the landscape and field. The proposed research is performed in the field, which represents actual conditions. Our objectives are: 1. Determine imidacloprid residue in pollen and nectar of basswood trees from an imidacloprid soil and trunk injection; 2. Determine imidacloprid residue in pollen and nectar of native flowers, squash, and blueberry from soil applied imidacloprid; 3. Determine the imidacloprid residue in native plants around imidacloprid-treated crops; and 4. The impacts of these imidacloprid residues on colony health of native bumblebee colonies. This research is different from our 2010 LCCMR grant as all studies are done in the field and the previous study was done in the greenhouse. For the research and outreach products from the 2010 LCCMR grant visit "Pollinator conservation" (www.entomology.umn.edu/cues/pollinators/index.html). We have letters of support from the Minnesota Honey Producers and the Colorado Beekeepers.

## II. DESCRIPTION OF PROJECT ACTIVITIES Total: $326, 869

**Activity 1:** Determine imidacloprid residue in pollen and nectar of basswood trees from an imidacloprid soil and trunk injection. **Budget: $100,000**

| **Outcome** | **Completion Date** |
|---|---|
| *1. In the field, treat basswood trees with label rates of soil-applied and trunk-injected imidacloprid and measure the amount is soil, leaves, and pollen and nectar. We will understand if treatments of trees with systemic insecticides are at levels that can kill bees.* | *June 30 2017* |
| *2. Provide bees treated flowers and observe effects on bee colonies and foraging.* | |

**Activity 2:** Determine imidacloprid residue in pollen and nectar of native flowers, squash, and blueberry from soil applied imidacloprid. **Budget: $100,000**

| **Outcome** | **Completion Date** |
|---|---|
| *1. In the field, treat native flowers with label rates of soil drench imidacloprid and measure the amount found in soil, leaves, and pollen and nectar. We will understand if treatments of native plants with systemic insecticides are at levels that can kill bees.* | *June 30 2017* |
| *2. Provide bees treated flowers and observe effects on bee colonies and foraging.* | |

**Activity 3:** Determine the imidacloprid residue in native plants around imidacloprid-treated crops. **Budget: $46,869**

| **Outcome** | **Completion Date** |
|---|---|
| *1. In the field, measure the amount of neonicotinyl insecticide in soil, water, pollen, and nectar of native plants around neonicotinyl-treated fields. We will understand if treatments with systemic insecticides are at levels that can kill bees.* | *June 30 2017* |

**Activity 4:** The impacts of these imidacloprid residues on colony health of native bumblebee colonies. **Budget: $80,000**

| **Outcome** | **Completion Date** |
|---|---|
| *1. Set up colonies around treated field plots and monitor colony health and foraging of bumblebees. We will understand if treatments with systemic insecticides are at levels that can kill bees.* | *June 30 2017* |

## III. PROJECT STRATEGY

### A. Project Team/Partners

Vera Krischik, Department of Entomology, University of Minnesota; Partners: Minnesota Honey Producers Association and Colorado Bee Keepers

### B. Timeline Requirements

The project requires 3 years of research for field work and analysis from June 2014 to.2017.

**Research:** Imidacloprid neonicotinyl residue in plants and effects on bumblebee colonies in the field
**Outreach Talks:** Provide 12 talks around the state to present data and discuss the issue.
**Outreach materials:** Write and produce collaborative research papers and bulletins. Distribute bulletins on LCCMR sponsored website (www.entomology.umn.edu/cues/pollinators/index.html).

### C. Long-Term Strategy and Future Funding Needs

Our long term goal is to protect bees so they can pollinate native plants and crops to produce food for wildlife and people, and to ensure further generations of seeds and fruits. We will understand if systemic insecticides that are widely used in crops and landscapes, are at residue levels that are harming native bee and honey bee colonies.

# 2013-2017 Detailed Project Budget

***Protecting bees, Vera Krischik, PI, University of Minnesota***

## IV. TOTAL ENRTF REQUEST BUDGET: Three years

| **BUDGET ITEM** *(See list of Eligible and Non-Eligible Costs, p. 11)* | **AMOUNT** |
|---|---|
| | |
| **Personnel:** | |
| Graduate Student $19.39/hr + fringe (15.7% health insurance and $14,180 tuition) for 3 years | $123,894 |
| Undergraduate, $11.00 hr x 40 hrs/wk for 20 weeks for 3 years, 7% fringe | $28,248 |
| Lab technician: $16.00 hr x 40 hrs/wk +fringe 36.8% | $45,527 |
| **Research supplies:** Bioassays materials, rearing cages, bioassay containers, beneficial insects, equipment for applying insecticides, insecticides, smaller DBH ash trees to be planted on St. Paul campus, space rental St. Paul campus, greenhouse fees | $30,000 |
| **Residue analysis:** Measure with residue analysis the amount of imidacloprid in leaves, trunk, plants under trees, and soil adjacent to tree with ELISA quick test and HPLC-mass spec | $80,000 |
| **Travel:** Instate travel to research sites (Fleet Services vehicle 6 days/months x 4 months @ $100/day per year for all 3 years) | $7,200 |
| **Greenhouse bench fees and field** space rental St. Paul campus, greenhouse fees | $6,000 |
| **Publication:** Cost for duplicating management recommendations, factsheets, handouts for use at meetings and talks.Publication costs for research papers, website. | $6,000 |
| **TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =** | **$326,869** |

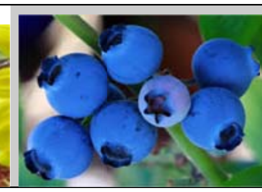
## V. OTHER FUNDS

| **SOURCE OF FUNDS** | **AMOUNT** | **Status** |
|---|---|---|
| **Other Non-State $ Being Applied to Project During Project Period:** None are secured or pending at the present time. | $ - | |
| **Other State $ Being Applied to Project During Project Period:** | $ - | |
| **In-kind Services During Project Period:** 1% PI cost share | $ 3,205 | *Secured* |
| **Remaining $ from Current ENRTF Appropriation (if applicable):** | $ - | |
| **Funding History:** USDA SARE grant 2010 $175,000: Bayer Chemical Company 2004-2008 $90,000 | $ 265,000 | |

**2014 LCCMR proposal**
Project title: **Protecting bees by understanding systemic insecticides**
Project PI: Vera Krischik, Department of Entomology, University of Minnesota
**Letters of support from the Minnesota Honey Producers and the Colorado Beekeepers.**





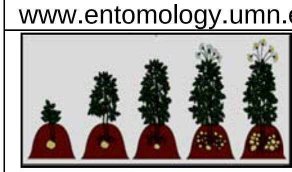


Bees feed on pollen and nectar to pollinate flowers to produce fruits and seeds.

AMERICAN BIRD CONSERVANCY

Honey bees are the buzz at U of M, Capitol - ABC Newspapers, Tim Budig, June 4, 2013 at 4:45 pm

Systemic neonicotinyl insecticides (imidacloprid or clothianidin) are widely used due to low toxicity to humans, but they are very toxic to bees and birds as addressed in 2 new review papers by the Xerces Society (2012) and American Bird Conservatory (2013). See the 2010 LCCMR pollinator website for research and outreach products and review papers at www.entomology.umn.edu/cues/pollinators/index.html.



Systemic insecticides move from the soil to the leaves and pollen and nectar of the plant, as shown in the drawing. Imidacloprid accumulates in pollen, nectar, and seeds from soil treatments and tree injections


To understand how little kills a bee or reduces foraging, let us think of a heart healthy aspirin that is 80 milligrams = 80,000 micrograms= 80,000,000 nanograms or ng. A bee is killed when it feeds on 4-40 ng of imidacloprid. That would be 40-400 ppb imidacloprid in pollen or nectar.

Seed treatments on canola use 0.11 mg of imidacloprid on the seed that results in 2 ppb in nectar and up to 10 ppb in pollen. These residue levels in pollen and nectar do not kill bees, but reduce foraging.

Much higher amounts of imidacloprid are used in field crops and landscape plants. In agriculture 4mg of imidacloprid/sgft can be applied which results in 14 ppb in squash and 122 ppb in pumpkin nectar. It is common for imidacloprid to be applied to basswood trees and native plants in gardens to kill insects. Under a basswood trees, 67g is applied or 270 mg is applied to flowering plants. We do not know how much imidacloprid accumulates in pollen and nectar and if there is enough to kill bees. Few studies exist, but 550 ppb were found in Eucalyptus nectar and that amount would kill a bee.

Our 2010 LCCMR research was done on potted plants and with bumblebee studies in the greenhouse. The proposed research is performed in the field, which represents actual conditions. Objectives are:
1. Determine imidacloprid residue in pollen and nectar of basswood trees from an imidacloprid soil and trunk injection; 2. Determine imidacloprid residue in pollen and nectar of native flowers, squash, and blueberry from soil applied imidacloprid; 3. The imidacloprid residue in native plants around imidacloprid-treated crops; and 4. The impacts of these imidacloprid residues on foraging and colony health of native bumblebee colonies in the field.

**Protect title: Protecting bees by understanding systemic insecticides**
**Project Manager Qualifications and Organization Description**

**Dr. Vera Krischik,** Assoc. Professor Ecology of Entomology of Urban Landscapes**,** Department of Entomology, University of Minnesota, St. Paul Campus

The PI is a tenured Faculty in the Entomology Department of the College of Food, Agricultural and Natural Resource Sciences at the University of Minnesota. One of the goals of the College is to develop viable food and agricultural systems, while maintaining healthy natural resources. The PI has over 30 years of research expertise and publications in this area. Equipment and facilities are available for this research.

Vera obtained her PhD from the University of Maryland in 1984, held a Post Doc at the University of Maryland, was a researcher at the New York Botanical Garden (NSF sponsored Visiting Professor for Women, 1991-1993), and was an IPM coordinator at USDA, Washington DC from 1988-1994. Since 1995, she is a professor in the Department of Entomology at the St. Paul, University of Minnesota. She teaches 2 courses: ENT 5009, Pesticide Use and Misuse and ENT 4015, Ornamental and Turf IPM. She has 6 published papers on the non target effects of imidacloprid on beneficial insects and 2 published papers and 2 in manuscript on the proper use of imidacloprid for landscape plants. She has three books: one published in 1991 by John Wiley entitled "Microbial Mediation of Plant Insect Interactions" and another published in 2004 by the MN Agricultural Experiment Station on "IPM of Midwest Landscapes", 316 pp. She has partnered with MDA, DNR, MNLA, MNTGF, and watershed districts for her outreach and research programs and publications. She has developed a plant restoration bulletin and poster in cooperation with the DNR and Ramsey Watershed District. She teaches at least 5 large workshops each year on proper pesticides use in cooperation with MDA and MNLA. She has trained 8 graduate students and 1 post doc. She is director of CUES: Center for sustainable urban ecosystems that promote natural resource management, online at www.entomology.umn.edu/cues. In 2010 Krischik received an LCCMR grant "Mitigating Pollinator decline". From the research 5 papers will be produced and 4 are in manuscript and 1 will be submitted by July 1 2013. Also, for outreach a poster on the right plants for bees, a protecting bee bulletin, pesticide and bee bulletin, and an online workshop are available at the CUES Website under "Pollinator Conservations" at http://www.entomology.umn.edu/cues/pollinators/index.html

**From 2010-2014 LCCMR**

**Research papers on neonicotinyls, bees, and beneficial insects, for manuscripts see LCCMR sponsored** "Pollinator Conservation" at
http://www.entomology.umn.edu/cues/pollinators/index.html

**Dr. Vera Krischik's experience with imidacloprid and management of landscape pests**
online at www.entomology.umn.edu/cues/krischiklab/krischik.htm


1. Tenczar, E. G., and V. A. Krischik. 2007. Comparison of standard (granular and drench) and novel (tablet, stick soak, and root dip) imidacloprid treatments for cottonwood leaf beetle (Coleoptera: Chrysomelidae) management on hybrid poplar. J. Econ. Entomol. 100: 1611-1621.
2. Krischik, V. A., A .Landmark, and G. Heimpel. 2007. Soil-applied imidacloprid is translocated to nectar and kills nectar-feeding *Anagyrus pseudococci* (Girault) (Hymenoptera: Encyrtidae) Environ. Entomol. 36(5): 1238-1245.
3. Rogers, M. A., V. A. Krischik, and L. A. Martin. 2007. Effect of soil application of imidacloprid on survival of adult green lacewing, *Chrysoperla carnea* (Neuroptera: Chrysopidae), used for biological control in greenhouse. Biological Control 42(2): 172-177.
4. Gupta, G., and V. A. Krischik. 2007. Professional and consumer insecticides for the