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College of Agriculture, Food and Environment

Designing Studies for Pesticide Impacts on Pollinators

D. Potter, UKY

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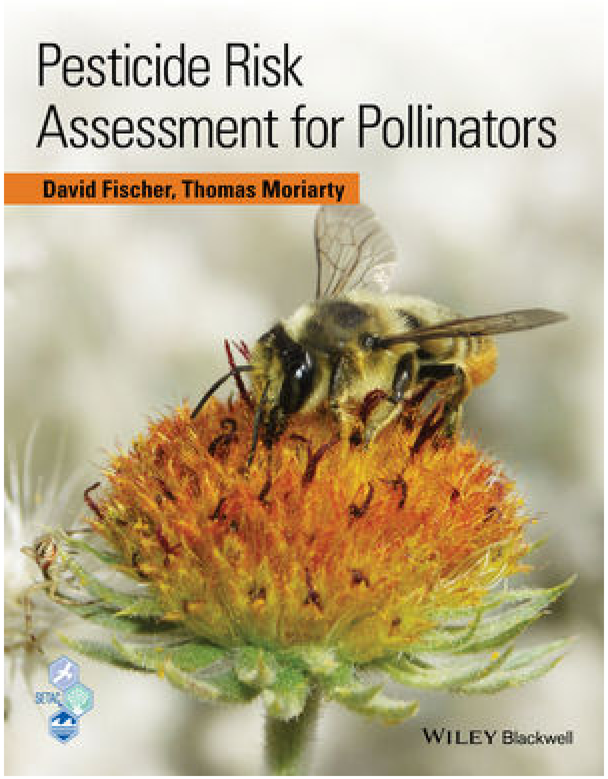

ss-risks-pollinators

EPA United States Environmental Protection Agency

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How We Assess Risks to Pollinators

EPA has improved how it evaluates the risks to bees resulting from the use of pesticides. This Web page provides an overview of the process.

Related Information

- Pollinator Risk Assessment Guidance
- FIFRA Peer Review: Proposed Risk Assessment Process
- Global SETAC Workshop

On this page:

- Overview of EPA's pesticide risk assessment process for bees
  - Initial assessment (Tier I)
  - More refined assessments (Tier II and III)
- Data for informing EPA's pesticide risk assessment process for bees
- More information

Overview of EPA's Pesticide Risk Assessment Process for Bees

Historically, EPA's pesticide risk assessment process for bees has been qualitative (i.e., not measured). The process relied primarily on developing an understanding of the types of effects that might be caused by the pesticide (hazard characterization), based on toxicity studies.

In 2011, EPA began expanding the risk assessment process for bees to quantify or measure exposures and relate them to effects at the individual and colony level. This involved identifying additional data that would be needed to inform that process. These data are summarized in the table below.

In November, 2012, EPA, in collaboration with Health Canada's Pest Management Regulatory Agency and the California Department of Pesticide Regulation, presented a quantitative risk assessment process for bees and other insect pollinators to the FIFRA Scientific Advisory Panel.

Guidance for Assessing Pesticide Risks to Bees

Office of Pesticide Programs
United States Environmental Protection Agency
Washington, D.C. 20460

Health Canada Pest Management Regulatory Agency
Ottawa, ON, Canada

California Department of Pesticide Regulation*
Sacramento, CA

*Currently, due to resource limitations, the California Department of Pesticide Regulation does not conduct full ecological risk assessments, but reserves the right to do so in the future.

June 19, 2014

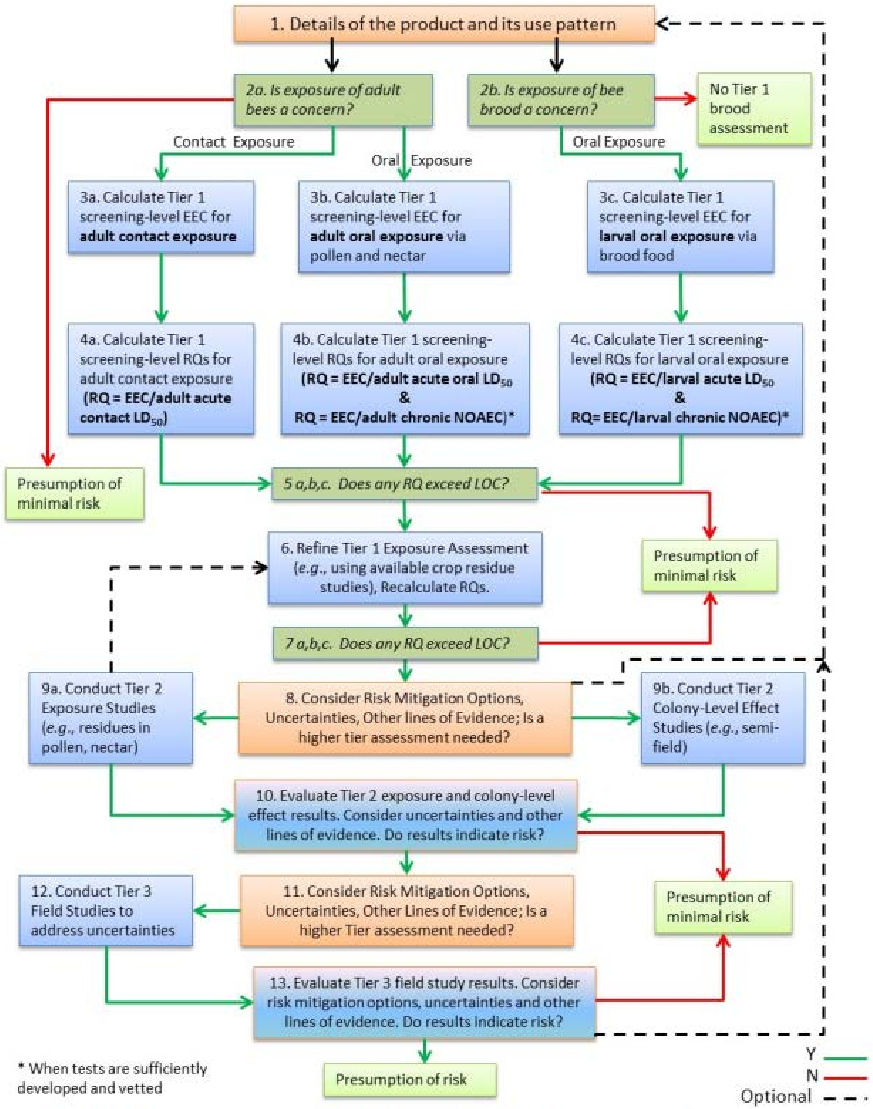


Figure 1. Tiered Approach for Assessing Risk to Honey Bees from Foliar Spray Applications.

“Future research should be with field-realistic concentrations, relevant exposure and evaluation durations.”

- USDA 2012

We know little about extent of bees' exposure to pesticides in urban landscapes

- **Which plants are most attractive?**
- **Do they have key pests targeted with systemic insecticides?**
- **If so, what percentage is treated, and when?**
- **Can hazard be mitigated by treatment timing, pruning, or other practices?**

On which plant(s) is systemic insecticide hazard to bees likely negligible?

Why?

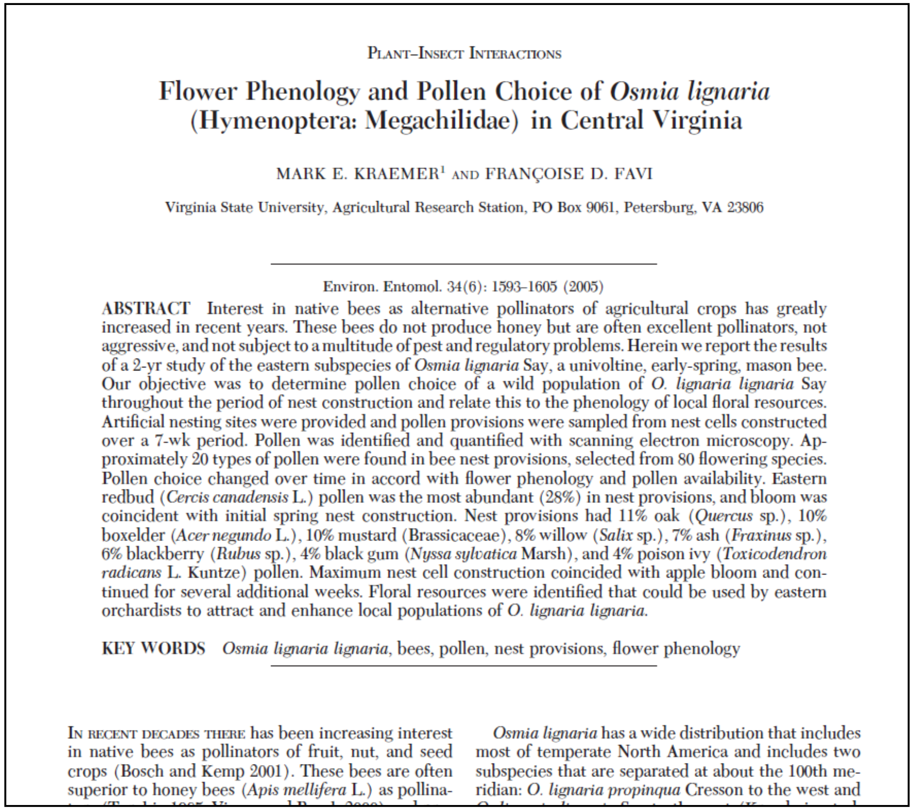
Deutzia gracilis

Boxwood

Hybrid tea rose

Two case studies on same native bee species (*Osmia lignaria*)

Case Study 1: *Osmia lignaria* as a generalist



Plant–Insect Interactions

Flower Phenology and Pollen Choice of *Osmia lignaria* (Hymenoptera: Megachilidae) in Central Virginia

MARK E. KRAEMER[1] AND FRANÇOISE D. FAVI

Virginia State University, Agricultural Research Station, PO Box 9061, Petersburg, VA 23806

Environ. Entomol. 34(6): 1593–1605 (2005)

ABSTRACT Interest in native bees as alternative pollinators of agricultural crops has greatly increased in recent years. These bees do not produce honey but are often excellent pollinators, not aggressive, and not subject to a multitude of pest and regulatory problems. Herein we report the results of a 2-yr study of the eastern subspecies of *Osmia lignaria* Say, a univoltine, early-spring, mason bee. Our objective was to determine pollen choice of a wild population of *O. lignaria lignaria* Say throughout the period of nest construction and relate this to the phenology of local floral resources. Artificial nesting sites were provided and pollen provisions were sampled from nest cells constructed over a 7-wk period. Pollen was identified and quantified with scanning electron microscopy. Approximately 20 types of pollen were found in bee nest provisions, selected from 80 flowering species. Pollen choice changed over time in accord with flower phenology and pollen availability. Eastern redbud (*Cercis canadensis* L.) pollen was the most abundant (28%) in nest provisions, and bloom was coincident with initial spring nest construction. Nest provisions had 11% oak (*Quercus* sp.), 10% boxelder (*Acer negundo* L.), 10% mustard (Brassicaceae), 8% willow (*Salix* sp.), 7% ash (*Fraxinus* sp.), 6% blackberry (*Rubus* sp.), 4% black gum (*Nyssa sylvatica* Marsh), and 4% poison ivy (*Toxicodendron radicans* L. Kuntze) pollen. Maximum nest cell construction coincided with apple bloom and continued for several additional weeks. Floral resources were identified that could be used by eastern orchardists to attract and enhance local populations of *O. lignaria lignaria*.

KEY WORDS *Osmia lignaria lignaria*, bees, pollen, nest provisions, flower phenology

In recent decades there has been increasing interest in native bees as pollinators of fruit, nut, and seed crops (Bosch and Kemp 2001). These bees are often superior to honey bees (*Apis mellifera* L.) as pollina-

Osmia lignaria has a wide distribution that includes most of temperate North America and includes two subspecies that are separated at about the 100th meridian: *O. lignaria propinqua* Cresson to the west and

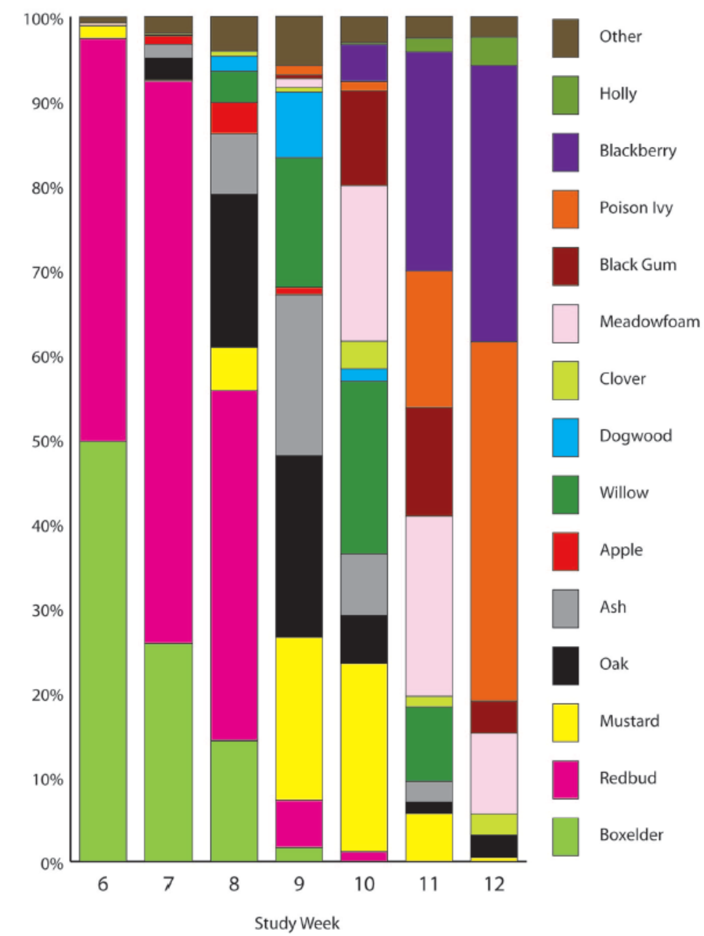
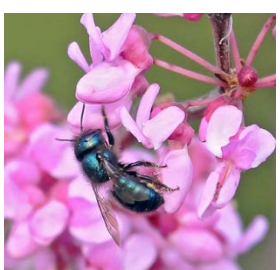


Fig. 2. Weekly change in pollen species in the nest cell provisions of *O. lignaria lignaria* Say from averages from 28 March to 15 May 2003 and 2004.



Case Study 2: Osmia lignaria as a facultative specialist

"We found the dominant pollen in every successful brood cell was either of one widespread, cosmopolitan lawn-invasive plant species (white clover) or of one of two wind-pollinated tree genera (oaks or birch). ***In combination, these three represented >90% of all pollen collected****…"*

Urban Ecosyst (2014) 17:139–147
DOI 10.1007/s11252-013-0321-4

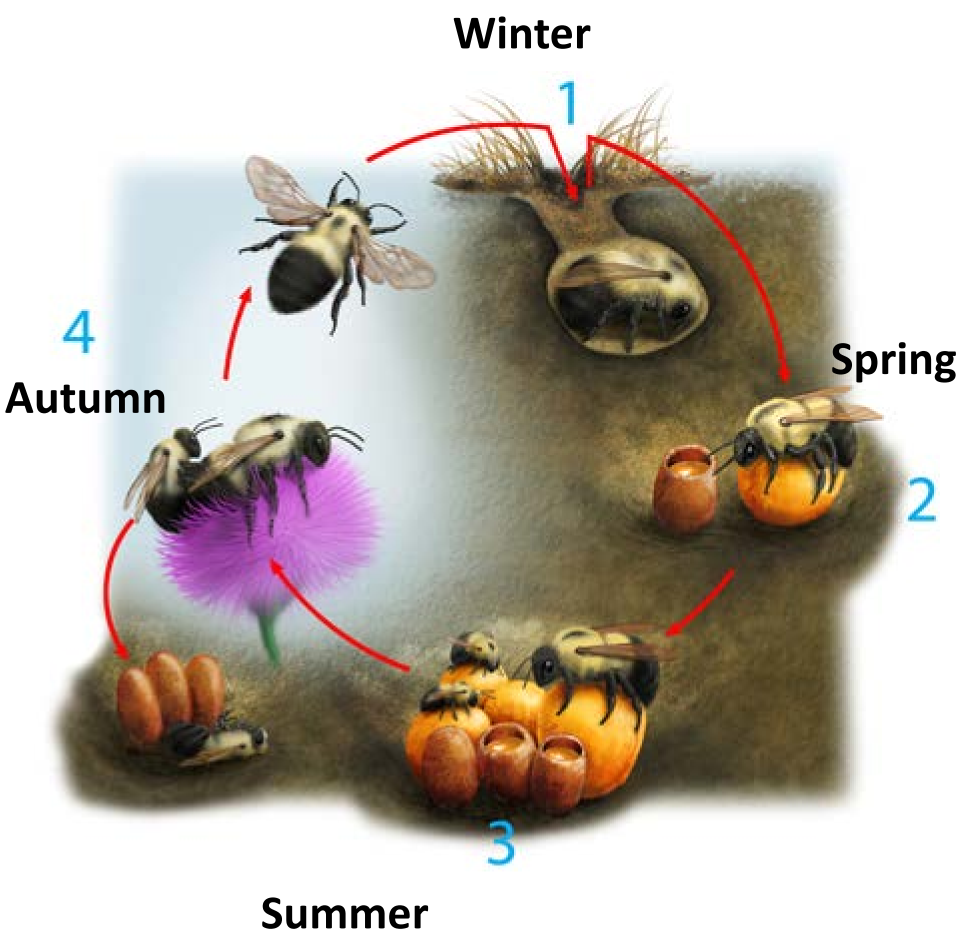
Pollen specialization by solitary bees in an urban landscape

J. S. MacIvor • J. M. Cabral • L. Packer

Abstract Many polylectic bee species are known to specialize locally on one or a few pollen types to increase foraging efficiency. What is relatively unknown is how different landscapes influence foraging decisions, and whether habitat alteration, such as that resulting from urbanization, influences broad-scale foraging activities of bees. This study evaluates the type and diversity of pollen collected by two solitary bees that are common in Toronto, Ontario, Canada, the native *Osmia pumila* and the exotic *O. caerulescens*, sampled in trap nests set up in urban parks and gardens. We found that the dominant pollen in every successful brood cell was either of one widespread, cosmopolitan lawn-invasive plant species (*Trifolium repens*) or one of two wind-pollinated tree genera (*Quercus* spp. and *Betula* spp.). In combination, these three represented more than 90 % of all pollen collected by each bee species. Despite considerable overlap in the dominant pollen types collected by each bee species, the exotic *O. caerulescens* was significantly more specialized than the native *O. pumila*. Brood cells with *Betula* as the dominant pollen type were more pollen

75% of pollen collected was from white clover!

Native bees may be the best models for urban landscape studies



Colonies start with a queen and a few workers in spring

Small colonies of bumble bees and mason bees allow replication with relatively low cost

University of KY Tier II Bumble bee studies

Evaluate potential hazard of spring preventive grub treatments to bees in lawn settings

Find ways to reduce those hazards

Jonathan Larson, PhD
2014

OPEN ACCESS Freely available online PLOS | ONE

Assessing Insecticide Hazard to Bumble Bees Foraging on Flowering Weeds in Treated Lawns

Jonathan L. Larson, Carl T. Redmond, Daniel A. Potter*

Department of Entomology, University of Kentucky, Lexington, Kentucky, United States of America

Environmental Toxicology

MOWING MITIGATES BIOACTIVITY OF NEONICOTINOID INSECTICIDES IN NECTAR OF FLOWERING LAWN WEEDS AND TURFGRASS GUTTATION

JONATHAN L. LARSON,†‡ CARL T. REDMOND,† and DANIEL A. POTTER*†

†Department of Entomology, University of Kentucky, Lexington, Kentucky, USA

‡University of Nebraska Extension, Omaha, Nebraska, USA

Ecotoxicology

DOI 10.1007/s10646-013-1168-4

Impacts of a neonicotinoid, neonicotinoid–pyrethroid premix, and anthranilic diamide insecticide on four species of turf-inhabiting beneficial insects

Jonathan L. Larson · Carl T. Redmond · Daniel A. Potter

We compared representative compounds from two chemical classes:

Neonicotinoid

Arena®

Clothianidin

Anthranilic diamide

Acelepryn® Insecticide

Chlorantraniliprole

University of KY Tier II Bumble bee studies

OPEN ACCESS Freely available online PLOS ONE

Assessing Insecticide Hazard to Bumble Bees Foraging on Flowering Weeds in Treated Lawns

Jonathan L. Larson, Carl T. Redmond, Daniel A. Potter*
Department of Entomology, University of Kentucky, Lexington, Kentucky, United States of America

Open-bottom cages for relevant (6 day) exposure

Tier II studies allow manipulations and reasonable control over other variables

University of KY Tier II Bumble bee studies

Direct versus systemic effects

Spray versus granular application

Dependent Variables and Endpoints

Foraging activity during or after colony exposure

Do bees avoid treated blooms?

Evaluating Colony Health after Exposure

Science AAAS

Neonicotinoid Pesticide Reduces Bumble Bee Colony Growth and Queen Production

Penelope R. Whitehorn,[1] Stephanie O'Connor,[1] Felix L. Wackers,[2] Dave Goulson[1]*

Growing evidence for declines in bee populations has caused great concern because of the valuable ecosystem services they provide. Neonicotinoid insecticides have been implicated in these declines because they occur at trace levels in the nectar and pollen of crop plants. We exposed colonies of the bumble bee *Bombus terrestris* in the laboratory to field-realistic levels of the neonicotinoid imidacloprid, then allowed them to develop naturally under field conditions. Treated colonies had a significantly reduced growth rate and suffered an 85% reduction in production of new queens compared with control colonies. Given the scale of use of neonicotinoids, we suggest that they may be having a considerable negative impact on wild bumble bee populations across the developed world.

Assessing long-term impacts on colony growth and reproduction

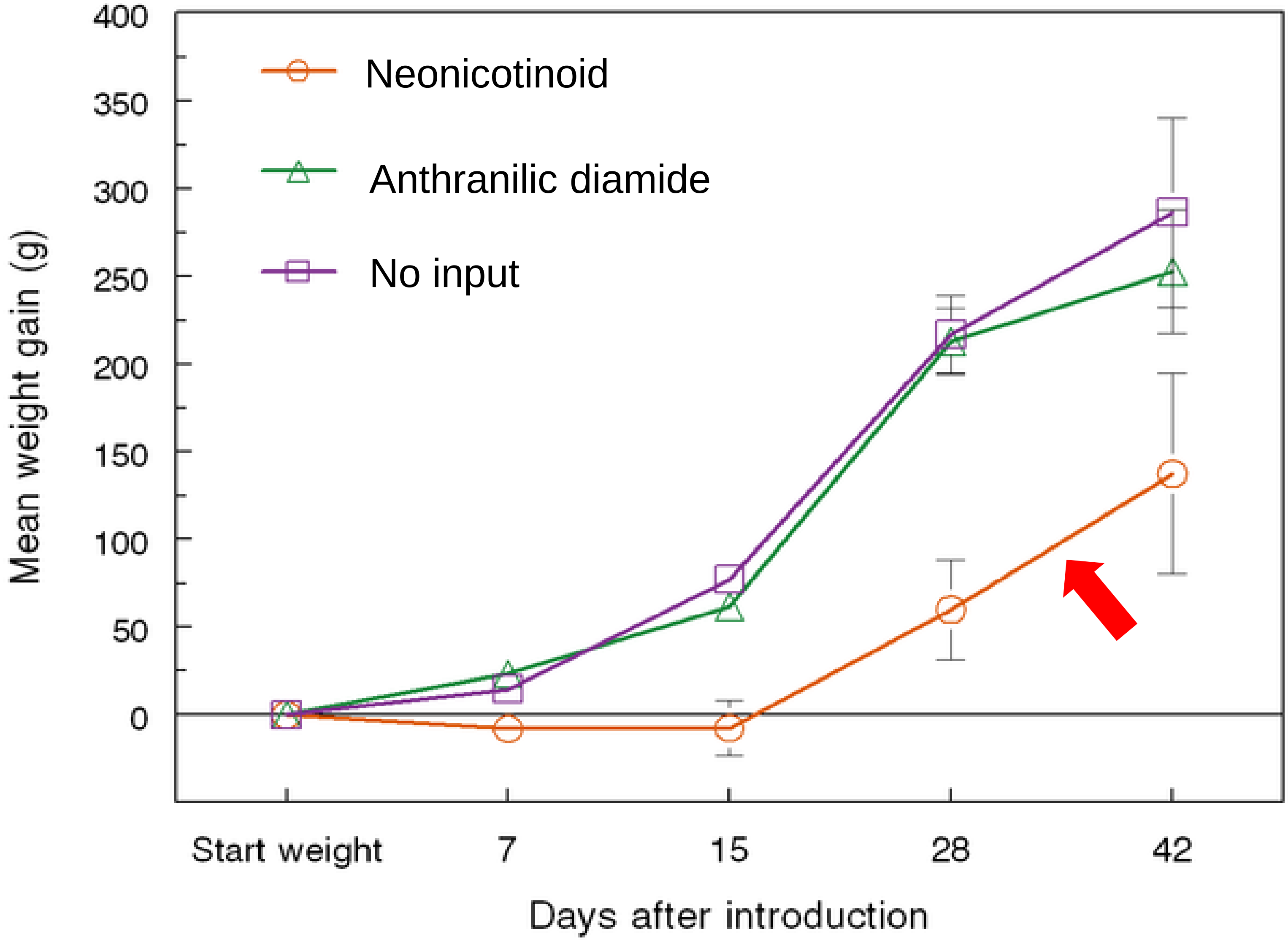
Larson et al. PLOSOne (2013)

Bees confined to forage on treated turf/clover for 6 days

Colonies moved to "safe site" to forage openly, grow, and reproduce

Assessing Interim Weight Gain of Colonies at Safe Site

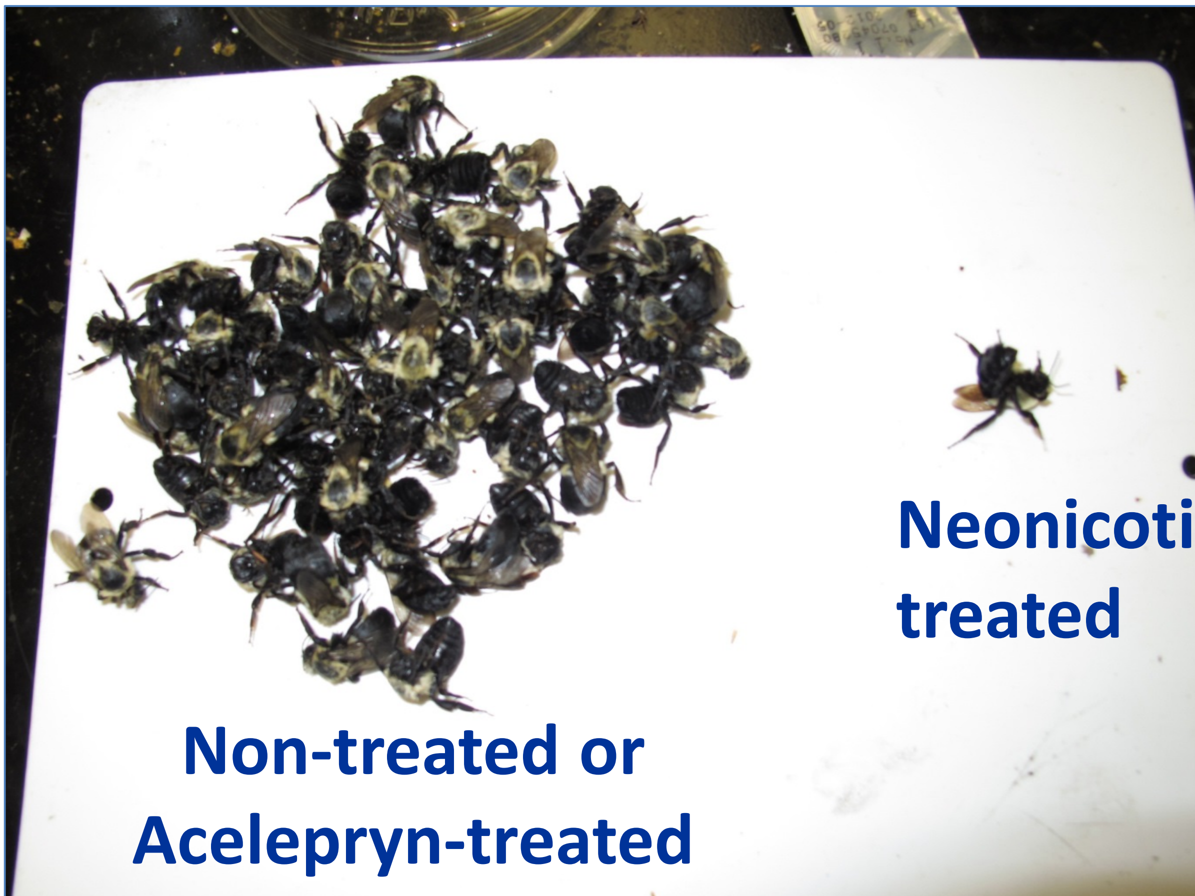
After initial 6-d exposure, colonies that had foraged on neonic-sprayed weedy turf failed to "catch up"



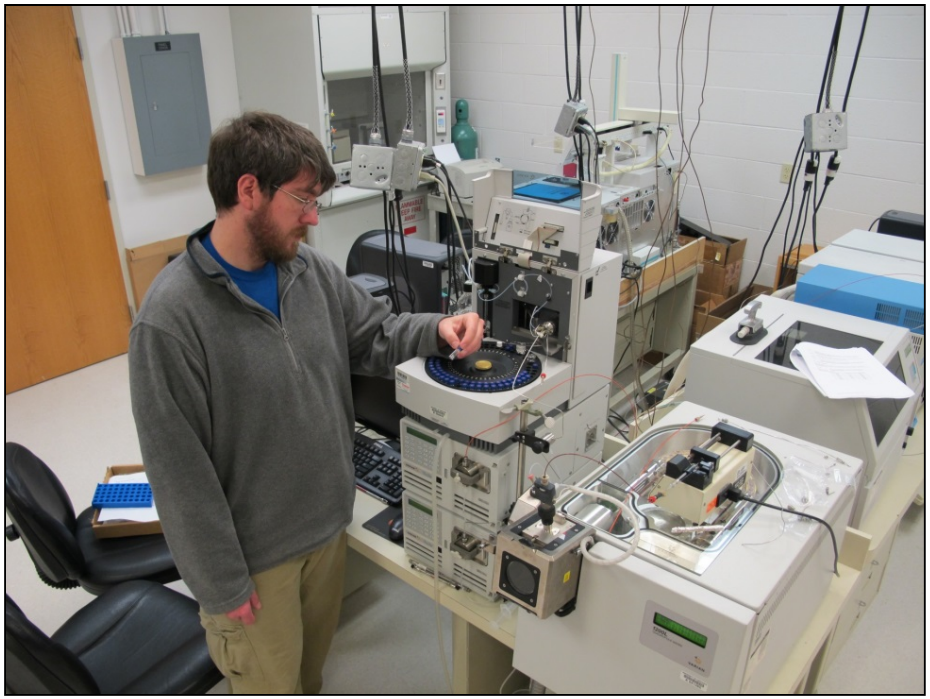
Assessing Colony Health

- Colony mass
- No. honey pots, brood cells
- No. and mass of workers, larvae, pupae
- No. and weight of new queens and adult males

Colonies whose workers foraged 6 days on oversprayed blooms <u>failed to produce new queens</u>



Supporting Assays



Analyzing residues in nectar of oversprayed clover versus blooms formed after mowing

Feeding assays with *Orius insidiosus* as a bio-indicator

Dave Smitley (MSU) has been evaluating acute effects of exposure to sprayed flowers and systemically-treated hanging baskets

New Project: 2014-2016

Bee Conservation and Woody Landscape Plants

- Document “bee-friendly” woody plants to spur sales of nursery stock and identify where bees may be at risk

- Develop Best Management Protocols for using systemic insecticides without harming bees

UK University of Kentucky College of Agriculture, Food and Environment

The Bayer Bee Care Program North America

VALENT

These are the 40 plants we are sampling (2014, 2015 and 2016):

Bee Assemblages:

50 bee samples from each of 5 sites per plant species

Attractiveness to bees:

“Snapshot” (1-min) counts; includes both attractive and non-attractive plant species

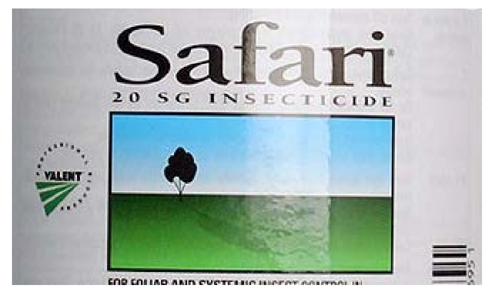
Residue Studies: 3 plant species


Foster holly


Winter King hawthorn


Summersweet

2 neonics



3 treatment timings

November

April

July

Some Discussion Questions

1. **What is the purpose for these studies?**
2. **How best to simulate real-world exposure? Can we move beyond cage studies?**
3. **What are the relevant endpoints?**
4. **What are interacting and extenuating factors?**
5. **Are studies with native bees adequate? If not, is it practical for landscape entomologists to do impact studies with honey bees?**