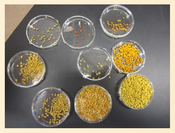
Protecting Pollinators with Economically Feasible and Environmentally Sound Ornamental Horticulture

USDA NIFA SCRI Grant 2016-51181-25399

What and how much to bee pollinators eat?

2017 CT Pollen Collection. Photos by Alejandro Chiriboga



The pollen collected from honey bee hives is being identified to determine 1) what ornamental plants honey bees use as pollen sources and 2) what ornamental plants contribute the most pesticide residue to honey bees through their pollen.

In Connecticut, honey bee hives were placed in three commercial plant nurseries and pollen was collected through the season from May to September. The pollen was tested for pesticides, and the samples with the highest pesticide toxicity to honey bees were sorted by color and each color was tested again for pesticides. The pollen is being identified by morphological characteristics observed with light microscopy (palynology).

In Pennsylvania, honey bee hives were placed in residential/ commercial landscapes in and around Philadelphia and its suburbs and pollen was collected throughout the season. This PSU team is developing DNA fingerprinting to identify plants to genera the honey bees collect. Using CT samples, the results from DNA fingerprinting will be compared to palynology.

Researchers: Drs. Kim Stoner, Andrea Nurse, Brian Eitzer, Rich Cowles, Christina Grozinger, Harland Patch, Doug Sponsler

States: CT, ME, PA

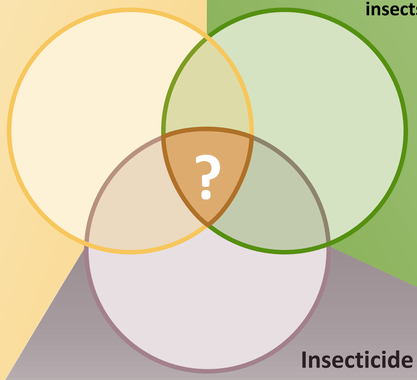
Objective 1. Pollinator Attractiveness of Ornamental Horticulture Crops

Pollinator

What and how much do insect (bee) pollinators eat?

Plant

Are plants good forage materials for insect (bee) pollinators?
How many forage plants are available in the landscape?
Are plants treated to manage pest insects?

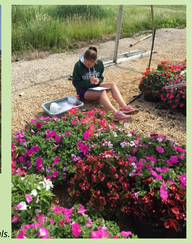


Insecticide

When are applications needed to manage pests, protect pollinators?
How much is needed?
What residues are present in pollen and nectar?

Are plants good forage materials for bees?

2016 PSU Pollinator Attractiveness Plots for Annuals. Photo by Nick Sloff.



2017 MSU Pollinator Attractiveness Plots for Annuals.

During 2017 and 2018, scientists in five locations throughout the United States have been studying the top 25 annuals and perennials grown in the US based on the USDA NASS Census of Horticulture 2014. They are counting the number of each pollinator group visiting of 3 to 5 cultivars of each plant species. Dr. Bethke is comparing coastal and inland pollinators.

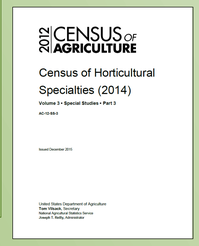
Dr. Potter also examined pollinator visitors on established native and non-native woody ornamentals in KY.

Researchers: Drs. Jim Bethke, Christine Casey & Elina Nino, JC Chong, Christina Grozinger, Harland Patch, Dan Potter, Dave Smitley, Kim Stoner

States: CA, CT, KY, MI, PA, SC

For the pollinator attractiveness plots, we selected from the top 25 annuals and herbaceous perennials by wholesale value listed in the USDA NASS Census of Horticulture 2014.

	CA (Casey)	CT (Stoner)	MI (Smitley)	PA (Grozinger/Patch)	SC (Chong)
Annuals	Salvia (annual) *Verbena sp.* *Zinnia elegans*	*Celosia sp.* *Zinnia angustifolia* *Zinnia elegans* *Zinnia haagenana* *Zinnia sp.*	*Begonia sp.* *Impatiens hawkeri* *Impatiens walleriana* *Pelargonium sp.* *Petunia sp.* *Viola tricolor*	*Lobularia maritima* *Pentas sp.* Salvia (annual) *Tagetes sp.* *Zinnia elegans* *Zinnia sp.*	*Antirrhinum majus* *Calabrachoa sp.* *Catharanthus roseus* *Portulaca sp.* *Solenostemon sp.* *Verbena sp.*
Herbaceous Perennials	*Achillea millefolium* *Echinacea sp.* *Lavandula sp.* *Penstemon sp.* *Perovskia atriplicifolia* Salvia (perennial)	*Echinacea purpurea* *Phlox sp.* *Sedum sp.*	*Chrysanthemum sp.* *Dianthus caryophyllus* *Dianthus chinensis* *Dianthus sp.* *Heuchera sanguinea* *Heuchera sp.*	*Echinaea sp.* *Rudbeckia sp.* Salvia (perennial)	*Astilbe sp.* *Coreopsis sp.* *Lavandula sp.* *Hibiscus sp.* *Iris sp.* *Veronica sp.*
Species of Common Cultivars	*Echinacea sp.* *Nepeta sp.* *Tagetes erecta* *Zinnia x marylandica*	*Echinacea sp.* *Nepeta sp.* *Tagetes erecta* *Zinnia x marylandica*	*Echinacea sp.* *Nepeta sp.* *Tagetes erecta* *Zinnia x marylandica*	*Echinacea sp.* *Nepeta sp.* *Tagetes erecta* *Zinnia x marylandica*	*Echinacea sp.* *Nepeta sp.* *Tagetes erecta* *Zinnia x marylandica*



How many pollinator forage plants are in the landscape?

We reviewed available pollinator attractiveness data from 11 published studies and the preliminary/non-analyzed 2016/2017 count data from our research team (CA, CT, KY, MI, PA, SC).

We normalized the reported count data to number of pollinators per 10 minutes and applied this scale:

- < 1 bee per 10 minutes = not or virtually not attractive (0)
- 1 up to 3 bees per 10 minutes = minimally attractive (1)
- 3 up to 10 bees per 10 minutes = moderately attractive (2)
- > 10 bees per 10 minutes = highly attractive (3).

The pollinators included in the preliminary attractiveness assessment included: Bumble Bees, Honey Bees, Other Bees (carpenter bees, cuckoo bees, dark hairy belly bees, green sweat bees, large dark bees, long-horned bees, metallic hairy belly bees, small dark bees, small sweat bees).

If a crop had a season-long average of greater than 2.5 for any bee species, the number of units sold were included in percentage calculation.
Season-long means when the plant was blooming.

Crops listed in the NASS Census of Horticulture 2014 were included in the calculations if there were attractiveness data available or if they are primarily sold as houseplants (ie African violet) or are wind pollinated (ie conifers).

We used number of units sold (pots, flats, etc) to calculate percent units attractive to pollinators.

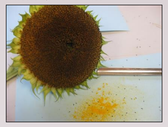
Preliminary conclusion: < 10% of units sold annually are bee attractive

Objective 2. Risk Assessment Data Gaps

What residues are present in pollen and nectar?

2017 NJ Nectar Collection. Photos by Cristi Palmer

2017 CT Pollen Collection. Photos by Rich Cowles



We selected model annual, herbaceous perennial and woody perennial crops to study residues based on these plants' ability to produce copious amounts of pollen and/or nectar that would be relatively easy for humans to harvest.

Pollen and/or nectar are being collected during bloom and are being analyzed for residues.

Researchers: Drs. JC Chong, Rich Cowles*, Brian Eitzer*, Cristi Palmer*, Dan Potter, Dave Smitley, Nishanth Thayaril*

States: CT, MI, NJ, PA, SC

Plant Type	Pollen	Nectar
Annual	Sunflower 'Taiyo' (*Helianthus* sp.)	Annual salvia (*Salvia splendens*) Snapdragon (*Antirrhinum majus*)
Herbaceous Perennial	Dahlia 'Bishop' series (*Dahlia sp.*)	Red Hot Poker (*Kniphofia uvaria*) Salvia 'Black & Blue'
Woody Perennial	Rhododendron PJM or *R. catawbiense boursault*	Rhododendron PJM or *R. catawbiense boursault* Geraldton Wax Flower (*Chamelaucium uncinatum*)

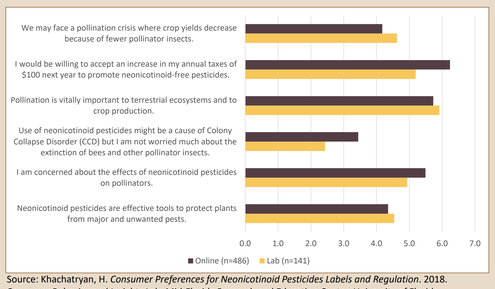
Objective 3. Economic, Efficacy, and Toxicological Comparisons of Alternatives

Objective 4. Public Perception of Management Practices & Point-of-Purchase Display Materials

What are consumer perceptions about systemic insecticides and pollinators?

Dr. Hayk Khachatryan conducted two laboratory and internet-based consumer experiments to assess consumer preference and willingness to pay for various attributes associated with pollinator attractive plants and protection of pollinators. Both incorporate the same questions with visuals and product attributes (pollinator labelling, pricing, etc). The laboratory study was conducted fall 2017, and the online survey was conducted winter 2018.

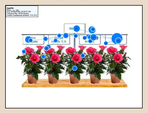
Data collected through the internet survey-based data has been used to 1) investigate the effectiveness of different information treatments and determine whether introducing additional information on neonicotinoids influences consumer purchase decisions, 2) to examine whether additional information treatments may have differentiated impacts on consumers' preference for labeling content (i.e., disclosing the absence or the presence of neonicotinoids), 3) to identify whether consumers with different prior beliefs/knowledge about neonicotinoids react differently to additional information.



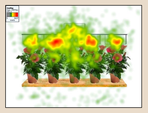
Source: Khachatryan, H. *Consumer Preferences for Neonicotinoid Pesticides Labels and Regulation*. 2018. Consumer Behavior and Insights Lab, Mid-Florida Research and Education Center, University of Florida.

Original Image

Gaze Plot of Image (n=1)



Heat Map of Image (n=104)



Objective 5. BMPs & Outreach

Outreach Activities

https://protectingbees.njaes.rutgers.edu/

Stakeholder Advisory Group

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Stephanie Darnell, Bayer Environ. Science
Dave Fischer, Bayer Environmental Science
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Gary Mangum, Owner, Bell Nurseries
Dustin Meador, CfAHR
Terril Nell, American Floral Endowment
Randy Oliver, Scientific Beekeeping
Ed Overdevest, Owner, Overdevest Nurseries
Jay Overmyer, Syngenta Crop Protection
Casey Sclar, American Public Gardens Association
Becky Sisco, IR-4 Western Region
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