Bees, Pesticides, and Politics

Challenges and Opportunities for Sustainable Urban Landscapes

Daniel A. Potter, Professor Emeritus
Dept. Of Entomology, Univ. of Kentucky

College of Agriculture, Food and Environment

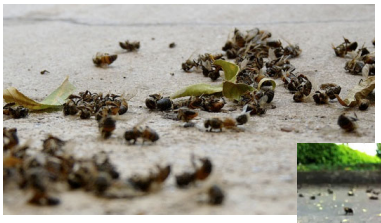
Delaware Nursery & Landscape Association

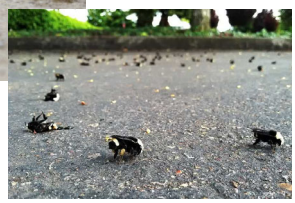
1

Early one June 2013 morning at an Oregon shopping center parking lot……

2

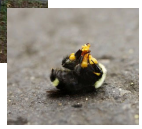
Shortly later, as shoppers begin to arrive…





The largest native bee kill ever recorded

3



Oregon Dept. of Agriculture officers

Endangered species conservation biologists

4

5

More backlash…..

Memorial Planned For Thousands Of Dead Bees In Wilsonville

6

Bumblebee incidents result in pesticide violations

Created on Friday, 03 January 2014 13:27 | Written by The Spokesman

ODA completes investigations, issues enforcement actions

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abcNEWS

State suspends pesticide operator's license after bee deaths

By News Staff | Published: Jun 20, 2014 at 3:44 PM PDT | Last Updated: Jun 20, 2014 at 5:19 PM PDT

Home / News / Pesticide restricted after bee kill | Restriction in place for 180 days

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Pesticide restricted after bee kill

Restriction in place for 180 days

By Shelby R. King / The Bulletin

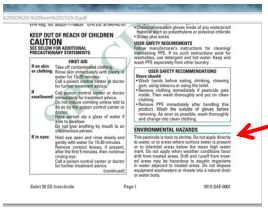
Published Jul 5, 2013 at 05:00AM

The Oregon Department of Agriculture announced last week a statewide restriction on 18 pesticide

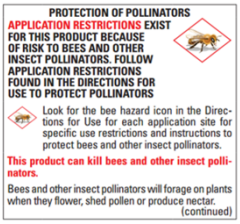
7

The Oregon bee kill resulted from a from a label violation

"This product is **highly toxic to bees**… Do not apply or allow it to drift to blooming crops or weeds if bees are visiting the treatment area"



More prominent "Bee Hazard" box now required on pesticide labels



8

Why all this attention on bees?

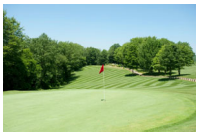
Home Depot and Lowe's:
STOP selling
bee-killing pesticides!

9

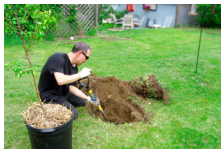
What challenges and opportunities does this issue pose for the Horticulture Industry?

Professional Land Care

Nurseries, Garden Centers



Golf courses



Home landscapes

10

Why care about bees?

Worldwide economic value of insect pollination is estimated at US $260 billion!

- Updated from: Ecological Economics 2008

Tomatoes

Melons, squash

Cherries

11

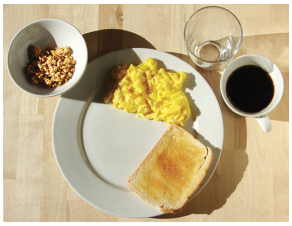
Without bees, they'll all be off the menu

12

Your breakfast…..

With bee pollination

Without bees



13

In parts of China, heavy agricultural spraying has nearly wiped out local bees

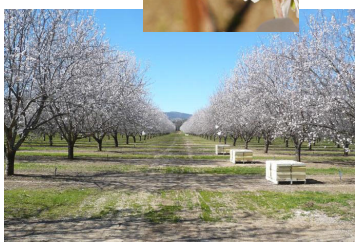
14

Farm workers must hand-pollinate millions of flowers to get fruit!

Jar of apple pollen

15

The California almond industry alone requires use of <u>1.4 million</u> honey bee colonies!



16

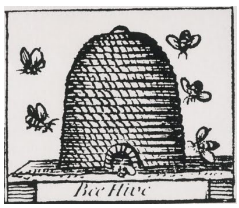
Why conserve <u>urban</u> bees?

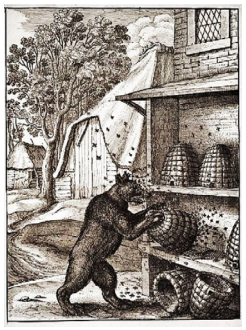
Bees pollinate our gardens and plants that provide food for urban wildlife

17

Honey bees are not native to America

Brought here by early colonists in 1622





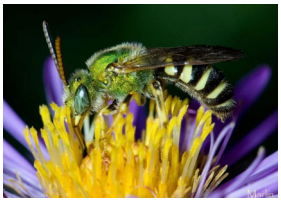
18

Besides honey bees…

4000 species of native bees also provide pollination services in the USA!

19

Some Familiar Native Bees


Sweat bees (Halictidae)


Mason, resin, & leafcutter bees (Megachilidae)


Bumble bees (Apidae)


Mining bees (Andrenidae)

20

Bees and Wasps are not the same

21

Bees and Wasps are NOT the same

Bees feed their young on pollen and nectar


Fuzzy, with branched hairs


Feeding time!

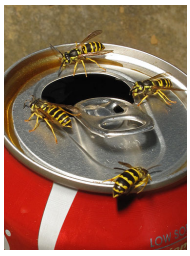
Body adapted to carry pollen


Mason bee nest

22

Bees and Wasps are NOT the same

Wasps have little to no hair



Wasps feed their young on meat!

23

Honey bees are docile unless hive is threatened, and native bees rarely sting

Most stings in urban settings are from wasps!

24

Honey bees and native pollinators have been having a tough time of it

25

26

Why are honey bee populations struggling?

27

The **Varroa mite** is the greatest threat to honey bee health worldwide

These parasites feed on vital bee tissues, and also transmit deadly bee diseases

28

29

Why are honey bees struggling?

Exotic bee diseases

Deformed wing virus

***Nosema* fungus causes "dysentery" in bees**

30

Why else are honey bees struggling?

Smithsonian.com SMARTNEWS HISTORY SCIENCE INNOVATION ARTS & CULTURE TRAVEL

High Fructose Corn Syrup May Be Partly Responsible for Bees' Collapsing Colonies

High fructose corn syrup, the sugary compound in soda, is also fed to bees

Good

Not good

Real honey boosts baby bees' immune systems

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Why are honey bees struggling?

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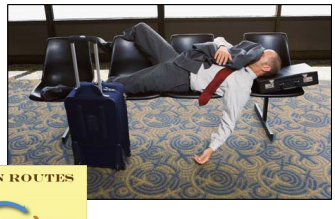
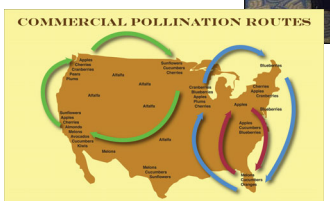
Why are honey bees struggling?

Travel stress!





33

But, most honey bees in North America are managed as semi-domesticated livestock

So beekeepers can intensify their practices to compensate for colony loss

34

Native bee populations are declining, in North America and worldwide. *Why?*

PNAS

Patterns of widespread decline in North American bumble bees

Sydney A. Cameron[a,1], Jeffrey D. Lozier[a], James P. Strange[b], Jonathan B. Koch[b,c], Nils Cordes[a,2], Leellen F. Solter[d], and Terry L. Griswold[b]

[a]Department of Entomology and [b]...
Research Service Pollinating Insects R...
and [d]Illinois Natural History Survey, ...

Edited* by Gene E. Robinson, Univer...

Bumble bees (Bombus) are vita... plants and agricultural crops worl... however, have suggested popu... American species. Despite rising... in the United States, highlightec... Sciences report, a national assess... possible causal factors of bumbl... report results of a 3-y interdiscip... tions, population genetic structur... in bumble bee populations acro... current and historical distributio... tabase of >73,000 museum recor... intensive nationwide surveys of ...

Review

Cell

Global pollinator declines: trends, impacts and drivers

Simon G. Potts[1], Jacobus C. Biesmeijer[2], Claire Kremen[3], Peter Neumann[4], Oliver Schweiger[5] and William E. Kunin[2]

[1] Centre for Agri-Environmental Research, School of Agriculture, Policy and Development, University of Reading, Reading, UK, RG6 6AR
[2] Earth and Biosphere Institute and Institute of Integrative and Comparative Biology, University of Leeds, Leeds, UK, LS2 9JT
[3] Department of Environmental Science, Policy and Management, University of California, Berkeley, CA 94720-3114, USA
[4] Swiss Bee Research Centre, Agroscope Liebefeld-Posieux, Research Station ALP, Schwarzenburgstrasse 161, CH-3003 Bern, Switzerland
[5] Department of Community Ecology, Helmholtz Centre for Environmental Research - UFZ, Theodor-Lieser-Strasse 4, 06120 Halle, Germany

Pollinators are a key component of global biodiversity, providing vital ecosystem services to crops and wild plants. There is clear evidence of recent declines in both wild and domesticated pollinators, and parallel declines

associated loss of pollination services impact floral biodiversity and human livelihoods. We assemble and appraise a diverse set of studies addressing the question of what are the actual drivers of observed pollinator declines and what

35

Why are Native bees declining?

Habitat loss!

36

70% of our native bees are ground-nesters



37

Many other native bees rear their young in cavities or hollow stems



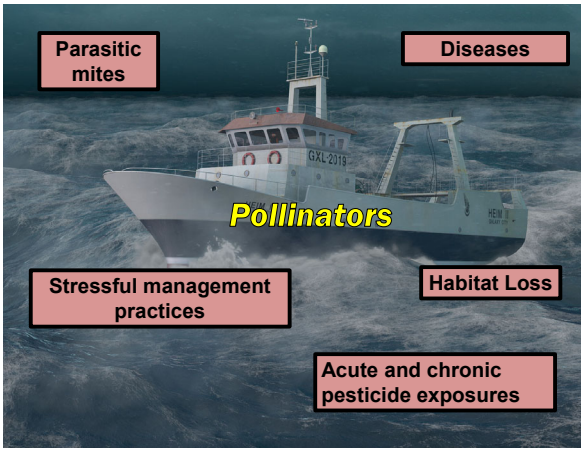
38

Why are ALL bees declining?
Environmental stressors

Less varied, less nutritious pollen & nectar

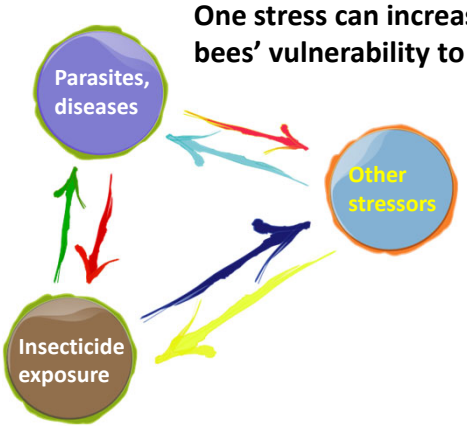
Acute or chronic exposure to pesticides

39



40

One stress can increase bees' vulnerability to others

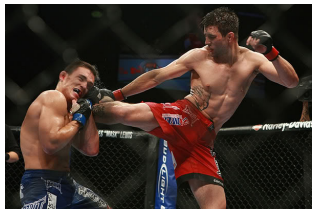


41

It is hard to recover from a concussion…

Varroa mites, diseases, management stress, habitat loss

If you are also being kicked in the head



Insecticide exposure

42

Public perception is that pesticides, esp. neonicotinoid insecticides are the main cause of bee decline

43

Neonicotinoids are a class of synthetic insecticides

They are much *less* toxic to humans and other mammals than to insects

Homeowner products with neonicotinoids

44

Neonicotinoids have been important tools in urban land care

Imidacloprid	Clothianidin	Thiamethoxam	Dinotefuran
MERIT 2F INSECTICIDE	Arena	Meridian	Safari INSECTICIDE

45

Neonicotinoids are relatively persistent in plants, providing extended pest control

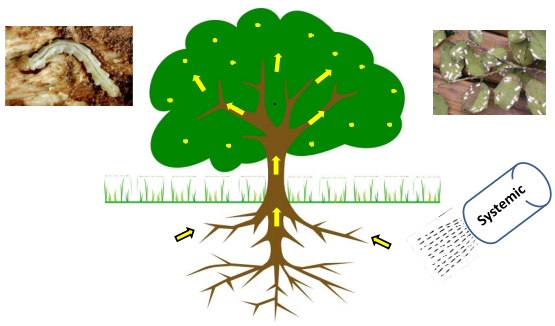
Emerald ash borer

White grubs

46

Neonicotinoids are **systemic insecticides**

They move upward in the plants' vascular system to all parts of the plant



47

Systemic applications are often more practical and less hazardous than sprays

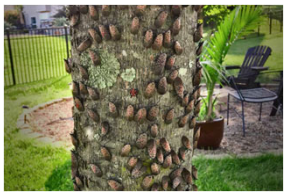
This……

Or this…

48

Systemics are the most effective available tools for managing many tree pests, incl. invasive ones

Hemlock wooly adelgid



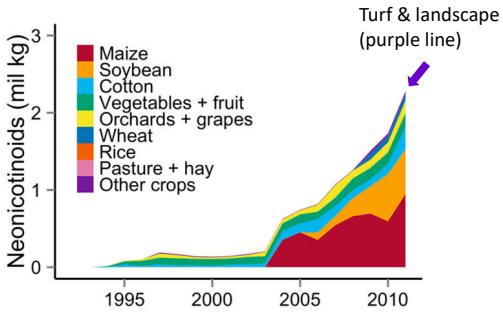
Spotted lanternfly

Emerald ash borer

Calico scale

49

Urban landscapes account for a tiny fraction of neonicotinoid use



Douglas & Tooker *Environ. Sci. Technol.* 2015

50

But… outdoor urban pest control is "low-hanging fruit" in debates about pesticides

LOCAL & STATE

Portland council votes 9-0 to ban synthetic pesticides in city

Hadlock Field, Riverside Golf Course and 5 athletic field will be the only exempt properties when the ordinance takes effect July 1.

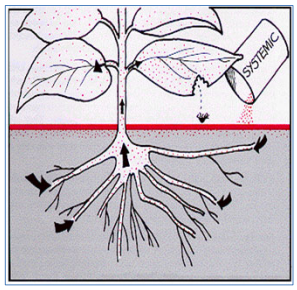
51

Although *urban* pest control is *not* the reason why bee populations are declining ….

…that does not mean that our insecticides are harmless to bees!

52

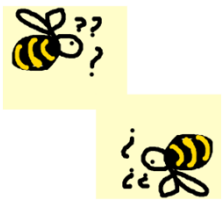
Bees can potentially be exposed via contact or systemic transference into pollen and nectar



53

At high enough dosages:

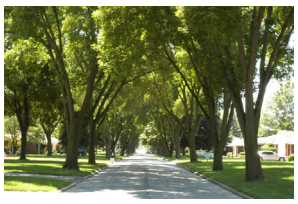
Neonicotinoids and pyrethroids can kill bees outright, or impair colony function

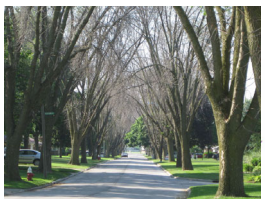


54

Fact:

All commercial insecticides that could have saved these trees are systemic, and intrinsically bee-toxic





Before (2006) After (2009)

Emerald Ash Borer: Toledo Ohio

Photos: D. Herms

55

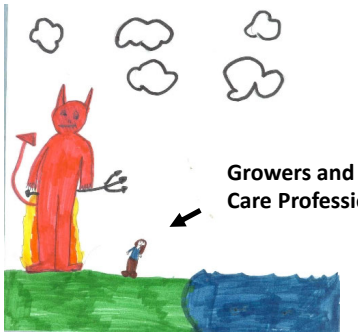
Difficult Questions…

Is there an acceptable threshold for bee hazard from insecticides?

If so, how should it be balanced against the pest management benefits ?

56

Between the Devil and the Deep Blue Sea…



Managing Pests **Safeguarding Pollinators**

57

What are some BMPs for safeguarding bees when applying insecticides?

58

My lab studied how to manage insect pests of lawns and landscapes without harming bees

ECOTOXICOLOGY

Hazards of Insecticides to the Bumble Bees *Bombus impatiens* (Hymenoptera: Apidae) Foraging on Flowering White Clover in Turf

JEROME A. GELS, DAVID W. HELD, AND DANIEL A. POTTER

Department of Entomology, University of Kentucky, Lexington KY 40546–0091

PLOS ONE

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

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

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*†

Environmental Toxicology

Uptake and Dissipation of Neonicotinoid Residues in Nectar and Foliage of Systemically Treated Woody Landscape Plants

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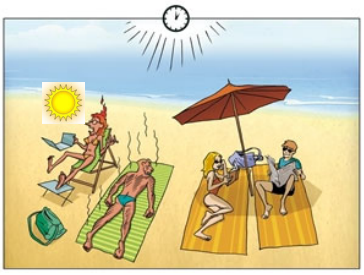
Hazard = Toxicity x Exposure



High exposure
High hazard

Low exposure
Low hazard

60

Model system for lawn studies:

White clover intermixed with cool-season turf



61

We compared lawn insecticides from three chemical classes:

Neonicotinoids

Arena

Clothianidin

MERIT

Imidacloprid

Anthranilic diamide

Acelepryn Insecticide

Chlorantraniliprole

Pyrethroids

TEMPO SC ULTRA

62

Products applied at label rates, with or without irrigation or mowing. Bees added 1 day later.




30 open-bottom cages

Hives started with queen & 20 workers

63

Weighing colonies in the field

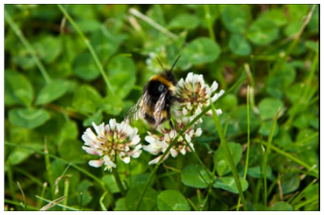
64

Evaluating Colony Health


65

The research showed…

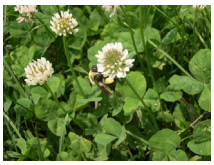
Direct exposure to neonics or pyrethroids on flowering lawn weeds is harmful to bees!




66

Will bees avoid sprayed flowers?

Counted bees for each day for 1 week

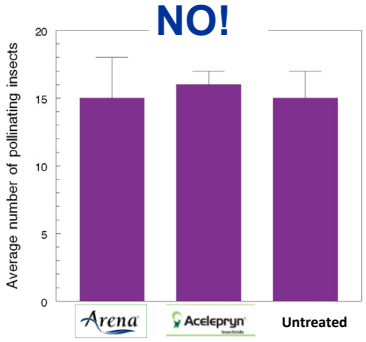


Larson et al *PLOS One* 2013

67

Will bees avoid sprayed flowers?

NO!



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What are some Best Management Practices (BMPs) to reduce bee hazard from neonics?

Mow off or control flowering weeds before treating for grubs

Granular formulations pose less bee hazard than sprays

- Larson et al. (2013) PLOSONE
- Larson et al. (2014) Ecotoxicology
- Gels et al. (2002) J. Econ. Entomol.

69

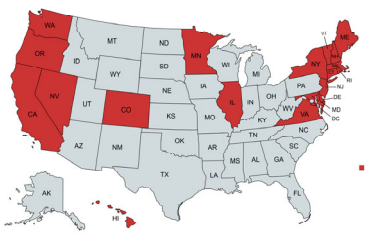
Residue levels (ppb) in clover nectar were reduced > 99% after one mowing!

	Directly sprayed	New blooms after mowing
Imidacloprid	5492	8.4
Clothianidin	2393	6.2

Larson & Potter, *Environ. Tox. Chem.* (2015)

70

Restrictions on neonics in urban landscapes have been enacted in at least 19 States



Source: National Caucus of Environmental Legislators (2024)

71

Importantly, our work showed that …

Chlorantraniliprole (Acelepryn®) is effective against pests and also non-hazardous to bees

Acelepryn® Insecticide

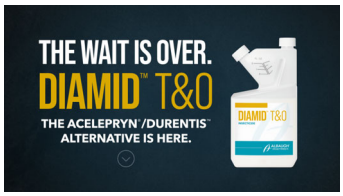
GREEN CHEMISTRY

72

Chlorantraniliprole recently went off patent

Less expensive generics will be available in 2025

Acelepryn Insecticide



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We've done similar studies with <u>woody</u> landscape plants

Environmental Toxicology

Uptake and Dissipation of Neonicotinoid Residues in Nectar and Foliage of Systemically Treated Woody Landscape Plants

Bernadette M. Mach,[a] Svetlana Bondarenko,[b] and Daniel A. Potter[a,*]

[a]Department of Entomology, University of Kentucky, Lexington, Kentucky, USA
[b]Valent U.S.A., Dublin, California

- Environ. Tox. Chem. 2017

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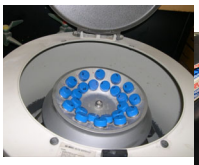
Collecting Nectar and Foliage for Residue Analyses

PhD student Bernie Mach collecting flowers

Prepping flowers

Twigs with blooms mounted in tubes



Centrifugation

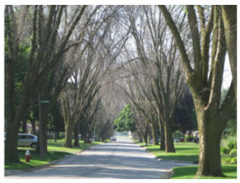
Nectar from 200-300 flowers extracted per tube

75

The research showed:

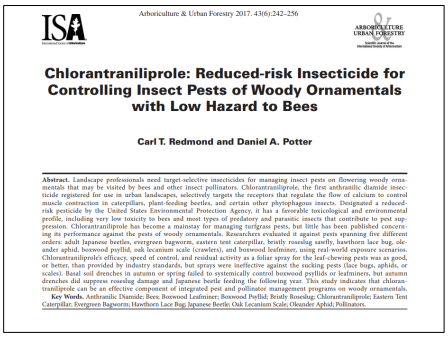
Bee-toxic neonic residues can persist for <u>at least a year</u> in nectar of trees and shrubs

So, don't use them on <u>bee-attractive</u> plants unless there is no other way to protect them



76

What are some "bee-friendly" alternatives to neonics?



Arboriculture & Urban Forestry 2017. 43(6):242–256

Chlorantraniliprole: Reduced-risk Insecticide for Controlling Insect Pests of Woody Ornamentals with Low Hazard to Bees

Carl T. Redmond and Daniel A. Potter

77

Acelepryn Insecticide

<u>Highly</u> effective for caterpillars, beetles, and sawfly larvae

But not very effective against the sucking pests; including lace bugs, aphids, or scales

78

Examples of synthetic insecticides that should pose relatively low bee hazard *so long as they're not used on plants in bloom*

Distance INSECT GROWTH REGULATOR

Talstar P PROFESSIONAL INSECTICIDE

(And other pyrethroids)

Talus 70DF Insect Growth Regulator

Lepitect

Confirm 2F INSECTICIDE

TRISTAR 30 SG Insecticide

79

An Excellent Free Resource

Michigan State Extension Bulletin E3314 (30 pages)

80

Lots of folks are about pollinators

My granddaughters Adele and Evie; Halloween 2017

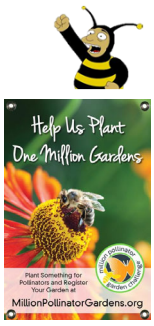
81

Pollinator-friendly land care is good for the industry

national pollinator garden network

82

The best way to help urban pollinators is to give them more and better food!



83

What can you do to help bees?

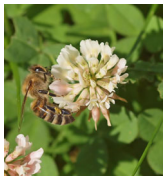
Leave white clover in low-input turf

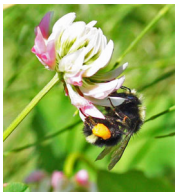
It provides pollen, nectar, and stepping stones between remnants of natural habitat

84

Our research showed:

Dutch white clover is great for honey bees and dozens of native bee species





Larson & Potter (2014)
Journal of Insect Conservation

85

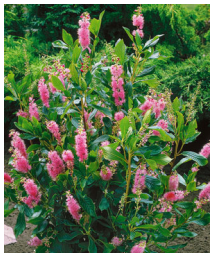
Increasing interest in flowering "bee lawns"

86

A single tree or shrub can provide 1000s of flowers with high-quality pollen and nectar

Kentucky yellowwood

Summersweet (Clethra)



87

We sampled 75 species of woody landscape plants
Five sites (replicates) per plant species

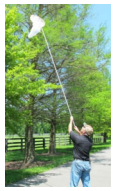
88

3 years, 375 sample sites!

Residential, commercial, & institutional landscapes

Arboreta

Cemeteries



Street trees

89

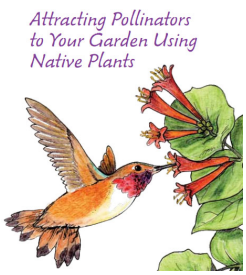
Different woody ornamentals attract unique bee assemblages

Flowering crabapple

Fuzzy Deutzia

90

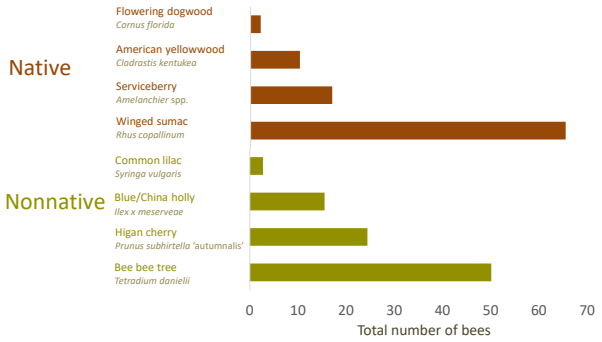
Are natives best for bees?



91

Native v. Non-native Woody Plants

Either can attract low or high numbers of bees



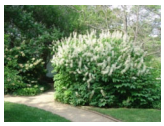
Mach & Potter PLoSone 2018

92

Examples of Bee-Attractive Native Trees


Eastern redbud


Chokecherry


Bottlebrush buckeye


Sourwood


Black gum


Yellowwood


Winged sumac


Devil's walking stick

93

Examples of Bee-Attractive Non-native Trees


Higan cherry


Amur maackia


Chaste tree


Cornelian cherry dogwood


Beebee tree


Seven sons flower tree

94

Examples of Bee-Attractive Native Shrubs


Summersweet


Winterberry holly


Buttonbush


St. John's Wort


Dwarf fothergilla


Sweetspire (Itea)


Virginia spiraea


False indigo

95

Examples of Bee-Attractive Non-Native Shrubs


Glossy abelia


Fuzzy deutzia


Cherry laurel


Panicle hydrangea


Pyracantha

96

Many of the best "bee magnets" are also nearly pest-free!


False Indigo


St. John's Wort


Fuzzy sumac


Chaste Tree


Glossy abelia


Seven-Son Flower


Amur Maackia

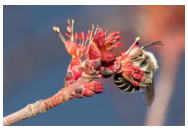
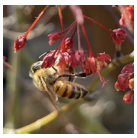

Black gum

1

97

Wind-Pollinated Trees Also Help Bees

Early-season Pollen Sources are Important



Maples (red, sugar, sycamore, Japanese, others)


Oaks (all species)


Elms (American, Chinese, others)


Filbert/Hazelnut

2

98

How to Build a Bee-Friendly Landscape

(Choose some from each column)

Spring	Early Summer	Late Summer
Serviceberry	Bottlebrush buckeye	Bee bee tree
Crabapple	Climbing prairie rose	Winged sumac
False Indigo	Clethra	Glossy abelia
Eastern redbud	Hydrangea paniculata	Seven son flower tree
Cornelian cherry	St. John's wort	Chaste tree
Winter king hawthorn	Winterberry	Devil's walking stick
American yellowwood	Golden rain tree	Buttonbush
Foster's holly	Amur maackia	
Flowering cherry	Virginia spirea	

3

99

Diversify landscapes, emphasizing native plants

Including some non-invasive non-natives can buffer pollinators from seasonal gaps in floral resources

Early spring


Cornelian cherry dogwood

Spring/Summer


Bottlebrush buckeye

Autumn


Seven sons flower tree

4

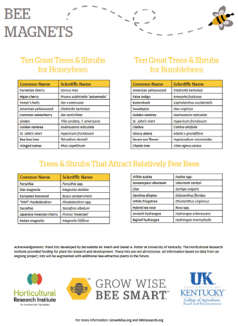
100

Handouts on the Conference Website…


PLANTS BEES LIKE BEST

Bee-Friendly Trees & Shrubs

All of these plants are regularly visited by bees!


BEE MAGNETS

Ten Great Trees & Shrubs for Honeybees

Ten Great Trees & Shrubs for Bumblebees

Trees & Shrubs That Attract Relatively Few Bees

5

101

Pollinator plants: good for business!

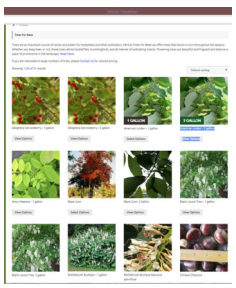

ROCK BRIDGE TREES

Trees Grown For Purpose for A Purpose

615-841-3664


TREES FOR BEES

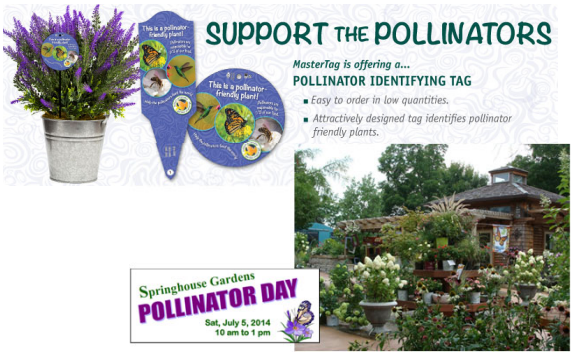
ROCK BRIDGE TREES



6

102

Marketing opportunities for growers and retailers



103

Integrated Pest and Pollinator Management (IPPM)

A few real-world examples

104

Customer freaks out about a honey bee swarm in a tree - wants you to spray it

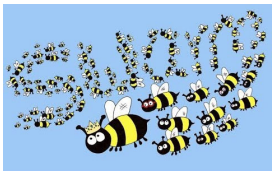
What should you do?

105

Why do honey bees swarm?

It's how they propagate the species

When a colony gets big enough, it splits and the queen flies off, taking a portion of the colony with her to find a new home.



106

The swarm rests while scout bees look for a tree hole or other place to make a new home

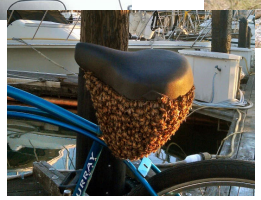
Swarms rarely stay in place for more than a day or so



107

While scouts are looking for a new home, swarms may make brief stopovers in strange places





108

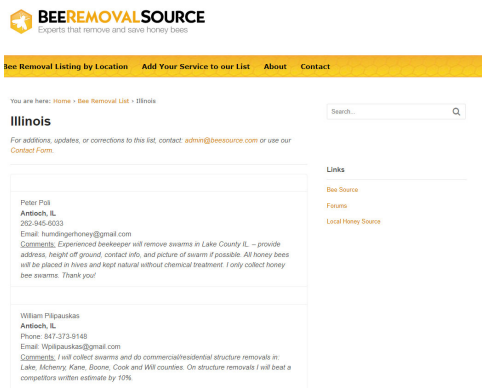
What should you do?

Reassure customer that swarming bees are not looking to attack you

Leave them alone – they'll be gone soon

Or, call a beekeeper – many will come remove swarm for free

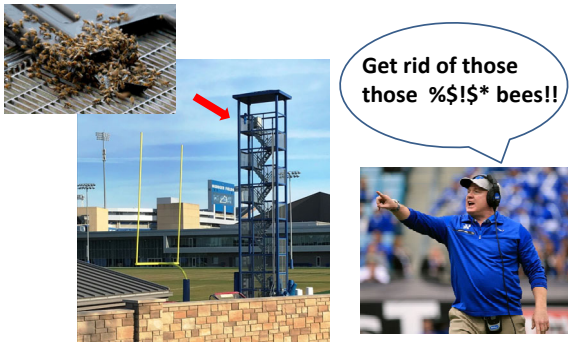
109



And 90 more listings!

110

UK Football Stadium – first day of Spring Practice.



111

Beekeeper to the rescue!

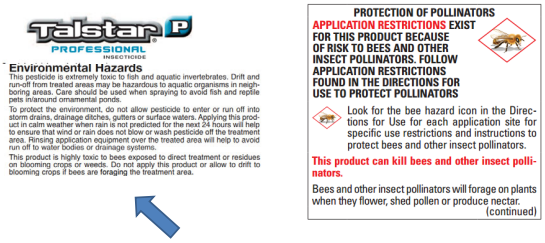
112

Customer is **afraid of bees** and **wants you to spray this tree to get rid of them**

What should you do?

113

Spraying that flowering tree would be a label violation!



Do not apply this product or allow to drift to blooming plants if bees are foraging the treatment area

114

What should you do? Reassure client….

Bees on flowers are not aggressive

Tree will only bloom and attract bees for a week or so – then they'll be gone

115

116

Take home point:

Bees benefit agriculture and urban habitats

117

Take Home Point:

Diversify landscapes with pest-resistant flowering plants

[Both natives and non-natives can help to support pollinators]

118

Safeguarding bees is good for the landcare industry

Bee kills are not

119

It's not rocket science….

Don't spray insecticides on blooming, bee-attractive plants

High bee hazard

Low bee hazard **if** plants not in bloom

120

Read and follow pesticide labels .....

And you'll come out smelling like a rose

121