FOR AUDIENCE PARTICIPATION, PLEASE GO TO: SIXLEGGEDAGGIE.COM/POLL

Landscape and Ornamental Integrated Pest Management

Erfan Vafaie
Extension Program Specialist IPM-II

sixleggedaggie.com
facebook.com/sixleggedaggie

NATURAL "CORN", 7000 B.C.

PEEL IT BY HAMMERING REPEATEDLY WITH A HARD OBJECT

TASTES LIKE VERY DRY, RAW POTATO

19 MM

5-10 VERY HARD KERNELS

8 KNOWN VARIETIES

ONLY FOUND IN CENTRAL AMERICA

ARTIFICIAL CORN, 2014

STEAM COOKS IN MINUTES

Sweet, refreshing and juicy

190 MM

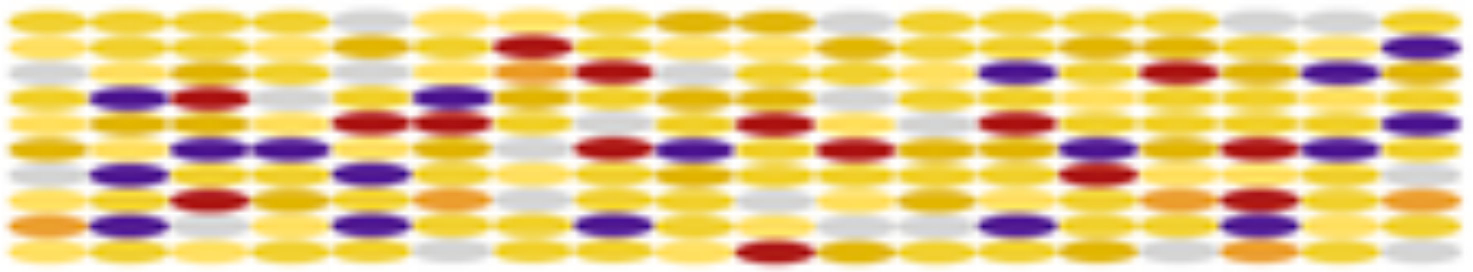
~1000 Times Larger

EASY TO PEEL

No Hammer Required!

AVAILABLE IN FIVE COLOURS:

- WHITE
- YELLOW
- DARK RED
- DEEP PURPLE
- BLUE-BLACK

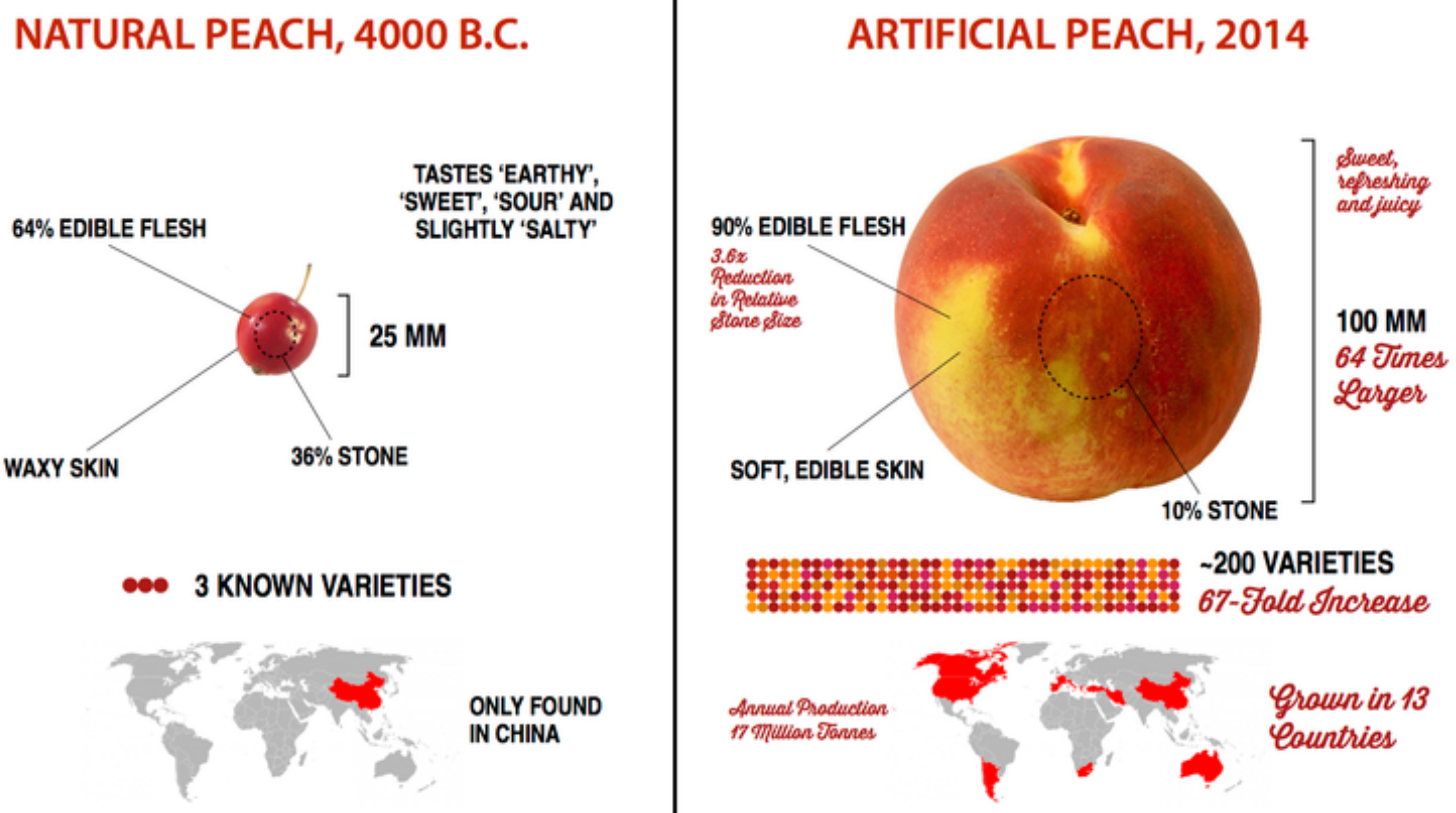


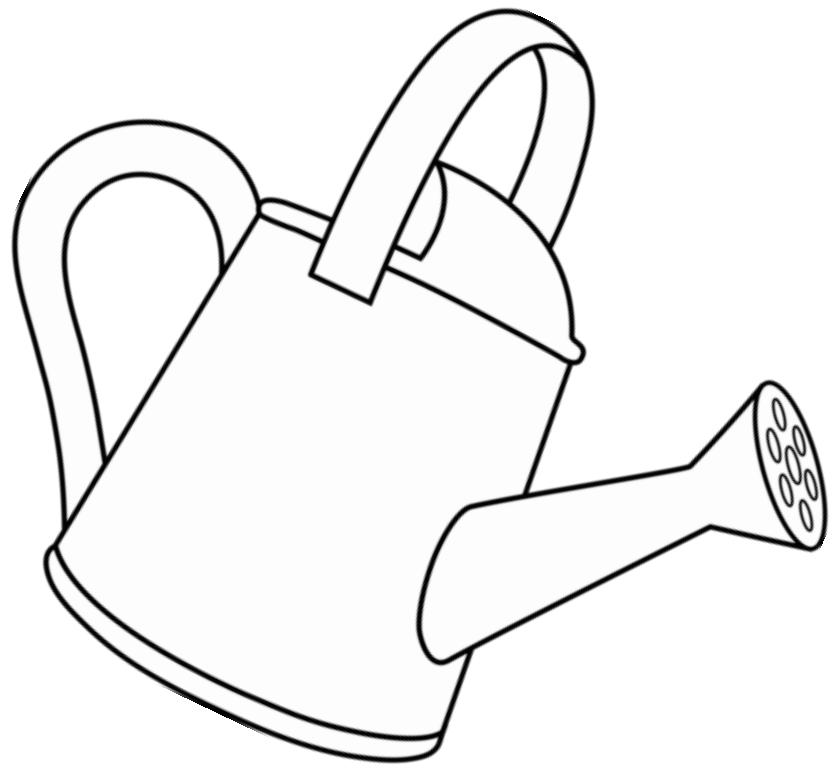
~200 VARIETIES

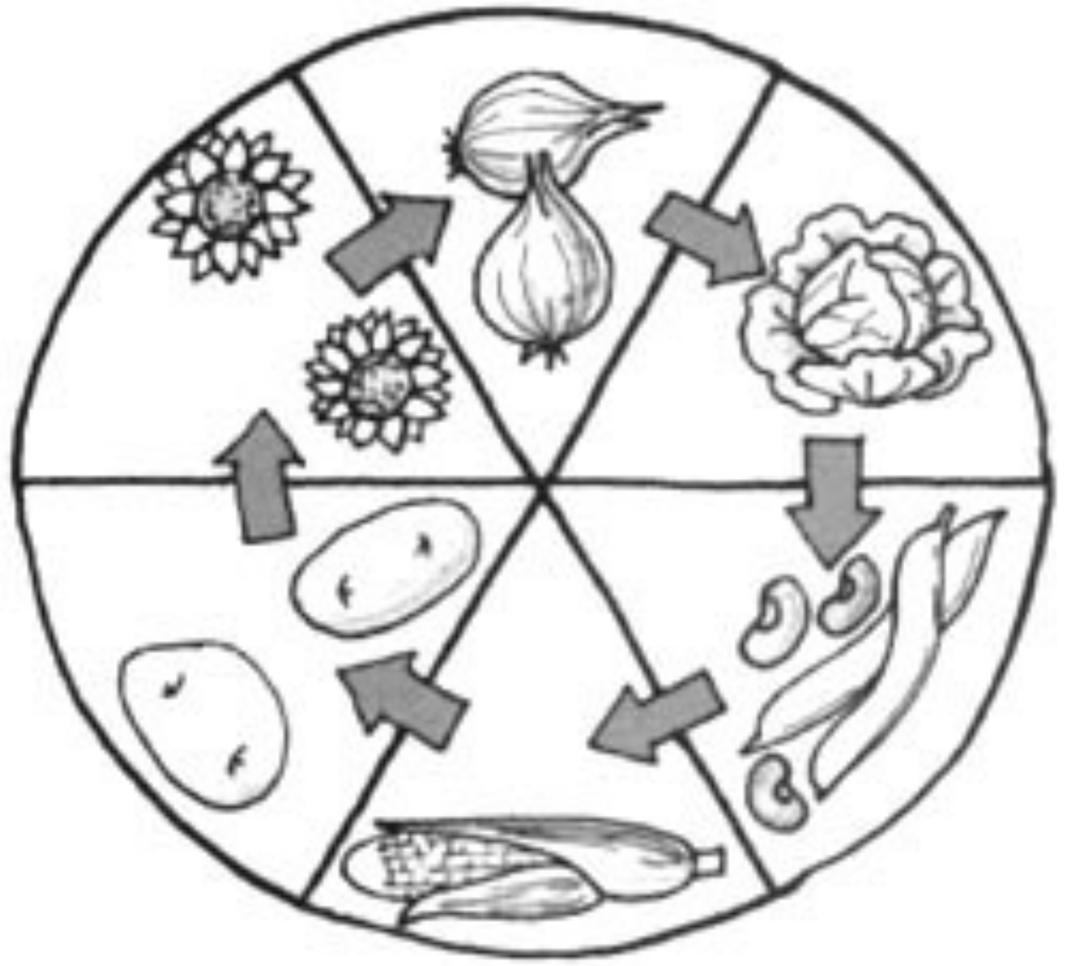
67-Fold Increase

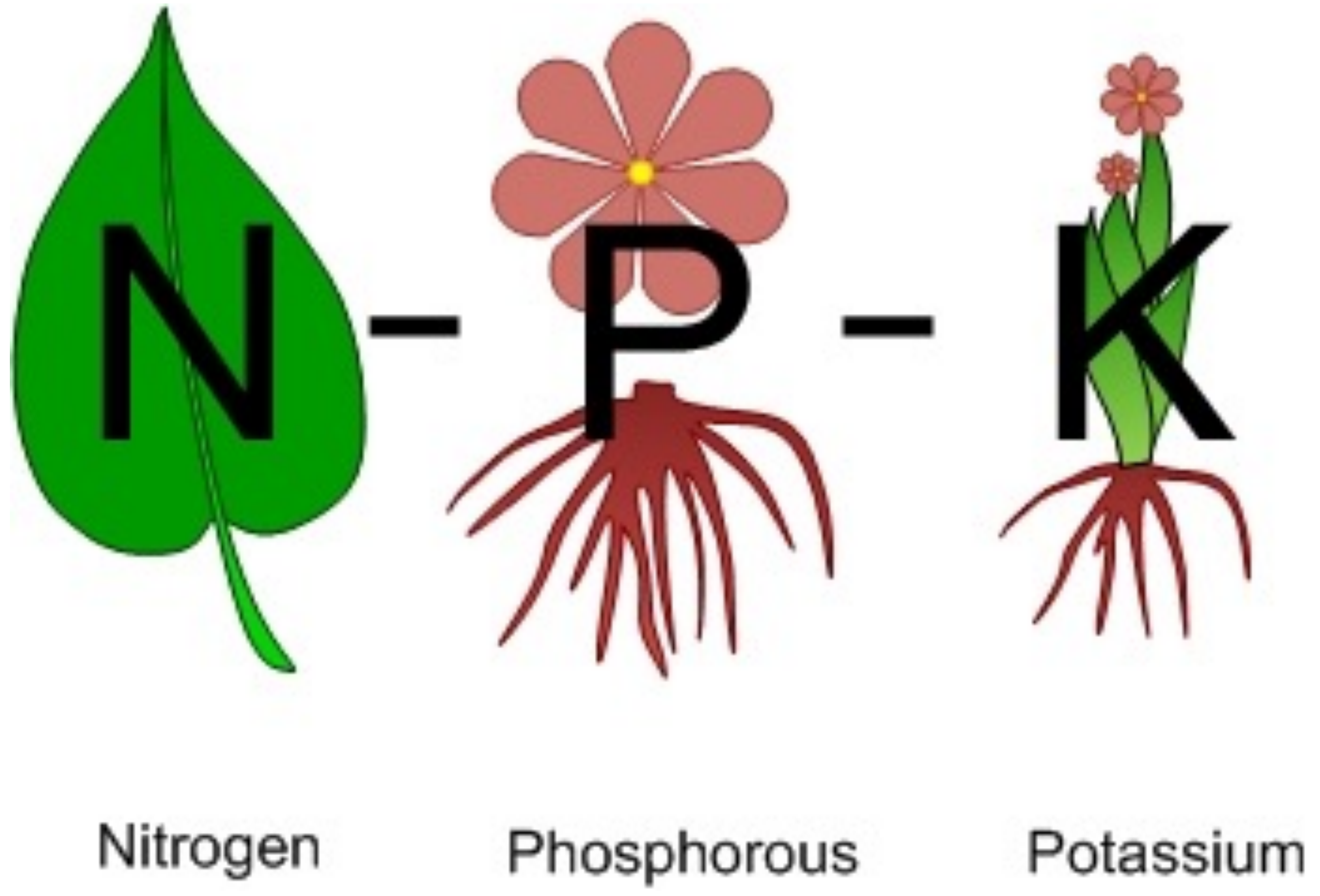
Annual Production: 790 Million Tonnes

Grown in 69 Countries


NATURAL PEACH, 4000 B.C.
TASTES 'EARTHY', 'SWEET', 'SOUR' AND SLIGHTLY 'SALTY'
64% EDIBLE FLESH
25 MM
WAXY SKIN
36% STONE
3 KNOWN VARIETIES
ONLY FOUND IN CHINA
ARTIFICIAL PEACH, 2014
Sweet, refreshing and juicy
90% EDIBLE FLESH
3.6x Reduction in Relative Stone Size
100 MM
64 Times Larger
SOFT, EDIBLE SKIN
10% STONE
~200 VARIETIES
67-Fold Increase
Annual Production 17 Million Tonnes
Grown in 13 Countries






N - P - K
Nitrogen
Phosphorous
Potassium

Texas A&M AgriLife Extension

The Green Revolution

- Between 1940’s - 1960’s
- “saved over a billion people from starvation”
- high-yielding varieties of cereal grains
- Expansion of irrigation infrastructure

Field Lab Earth

- Modernization of management techniques
- Distribution of hybridized seeds, synthetic fertilizers,and pesticides to farmers

Norman Borlaug

EPISODE 43

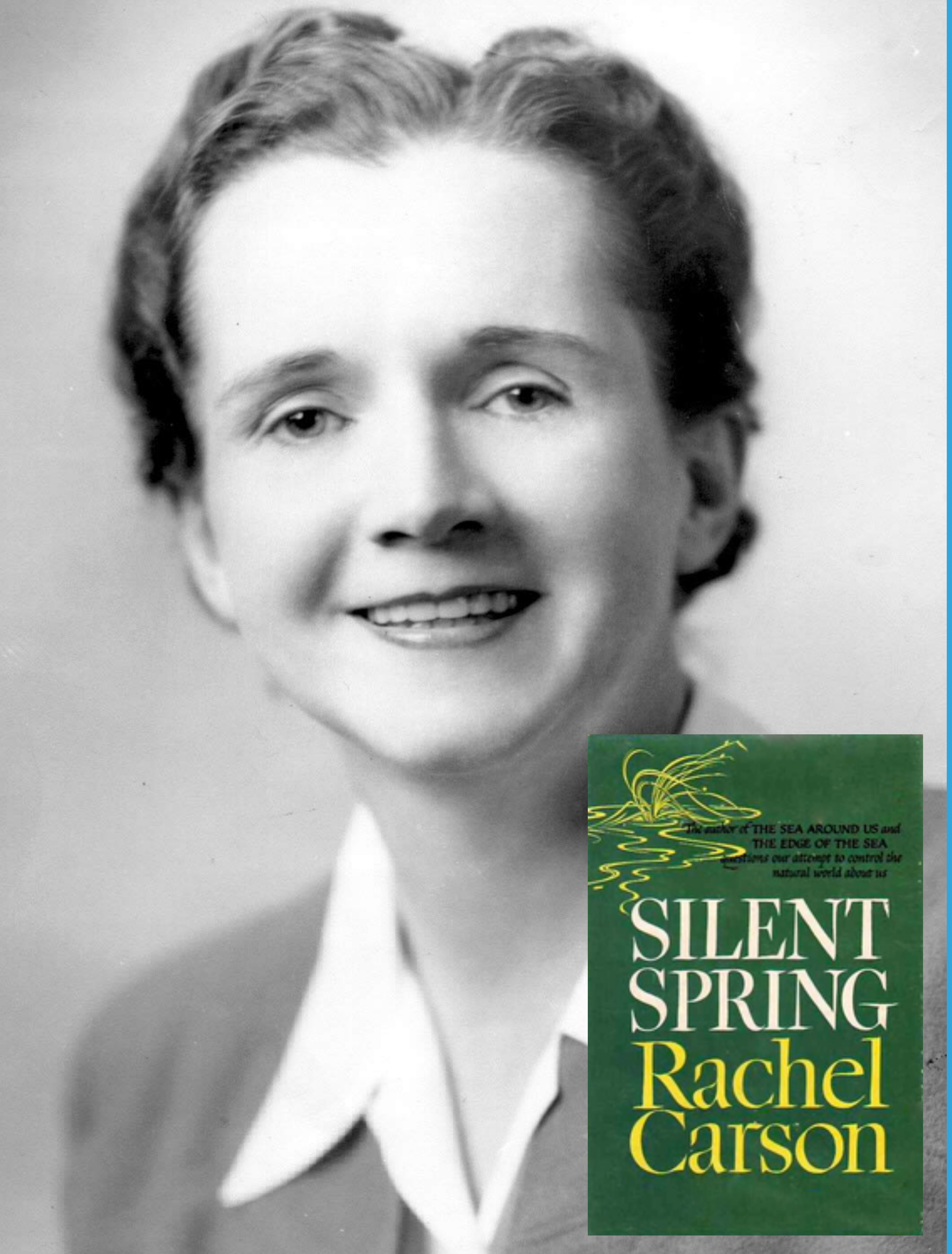
Dr. Norman Borlaug with Julie Borlaug, Dr. Ronnie Coffman, and Dr. Ed Runge

Field, Lab, Earth

Dr. Norman Borlaug was an American agronomist who specialized in wheat breeding. Known as the Father of the Green Revolution, he helped other hunger fighters save millions of lives in Mexico, India, Pakistan, and more. He won the Nobel Peace Prize in 1970 and founded the World Food Prize to celebrate other food fighters worldwide. This episode we speak with his granddaughter and colleague Julie Borlaug and fellow colleagues Dr. Ronnie Coffman and Dr. Ed Runge to discuss the “Man who Fed the World.”

502 Records
$ billions in economic impact

Spotted Wing Drosophila
Estimated revenue loss in 2008
$511.3 million



"WHY SHOULD WE TOLERATE A DIET OF WEAK POISONS, A HOME IN INSIPID SURROUNDINGS, A CIRCLE OF ACQUAINTANCES WHO ARE NOT QUITE OUR ENEMIES, THE NOISE OF MOTORS WITH JUST ENOUGH RELIEF TO PREVENT INSANITY? WHO WOULD WANT TO LIVE IN A WORLD WHICH IS JUST NOT QUITE FATAL?"

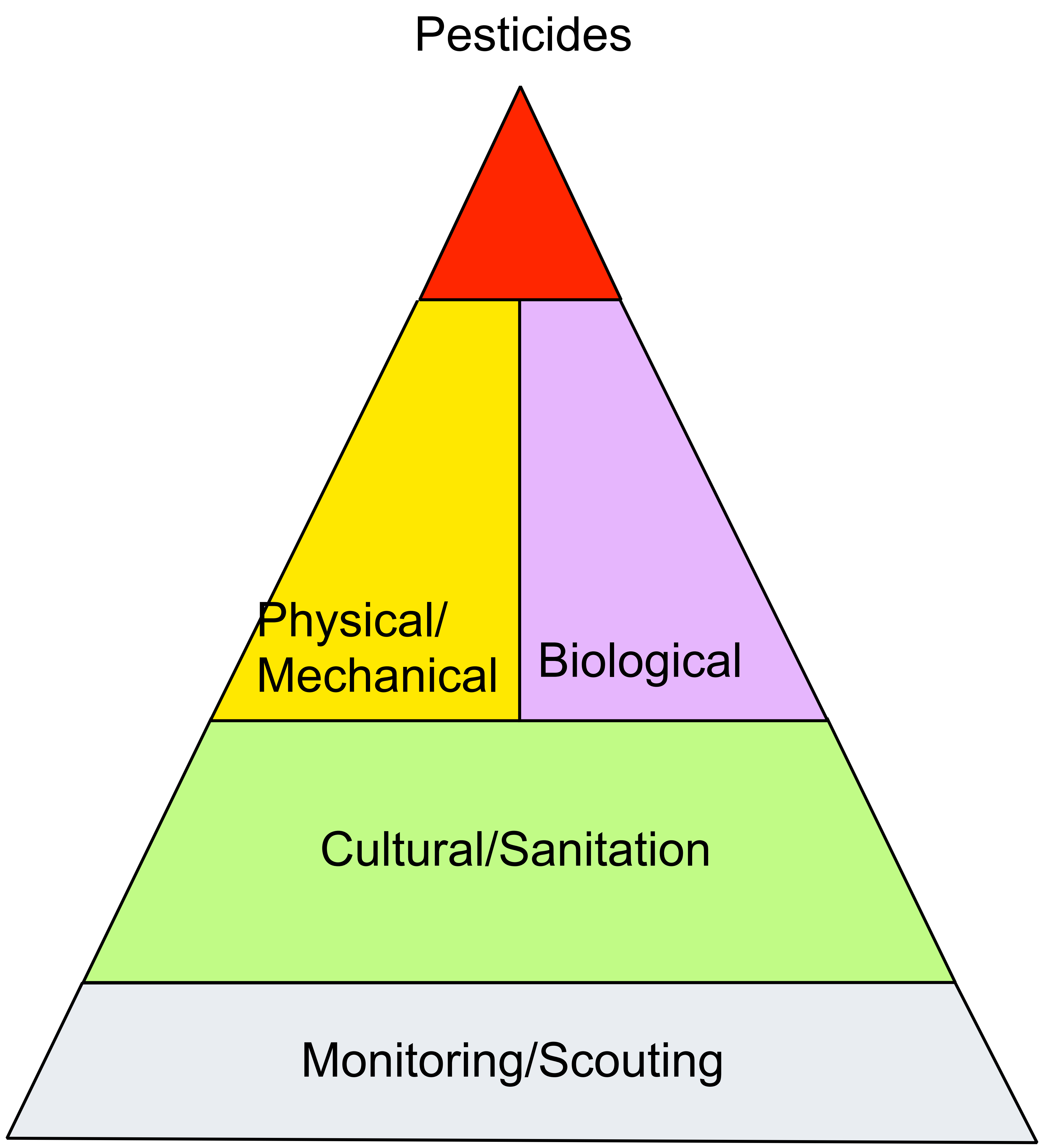
Rachel Carson, Silent Spring (1962)

1970's

USDA creates nationwide IPM program in Land Grant Universities

The IPM Pyramid

- Minimize impact on the environment
- Minimize impact on human health
- Maintain or increase soil fertility
- Long-term pest management
- Prevent pesticide-resistant pests
- Strives to maximize long-term returns/savings



Monitor | Tools of the trade

Monitor | Tools of the trade

Sweep net

Figure 15. Proper use of a sweep net.

Photo: NC State University

Monitor | Tools of the trade

Slap/Beating technique

Scot Nelson

Monitor | Tools of the trade

Pheromone Traps | Sweet potato weevil

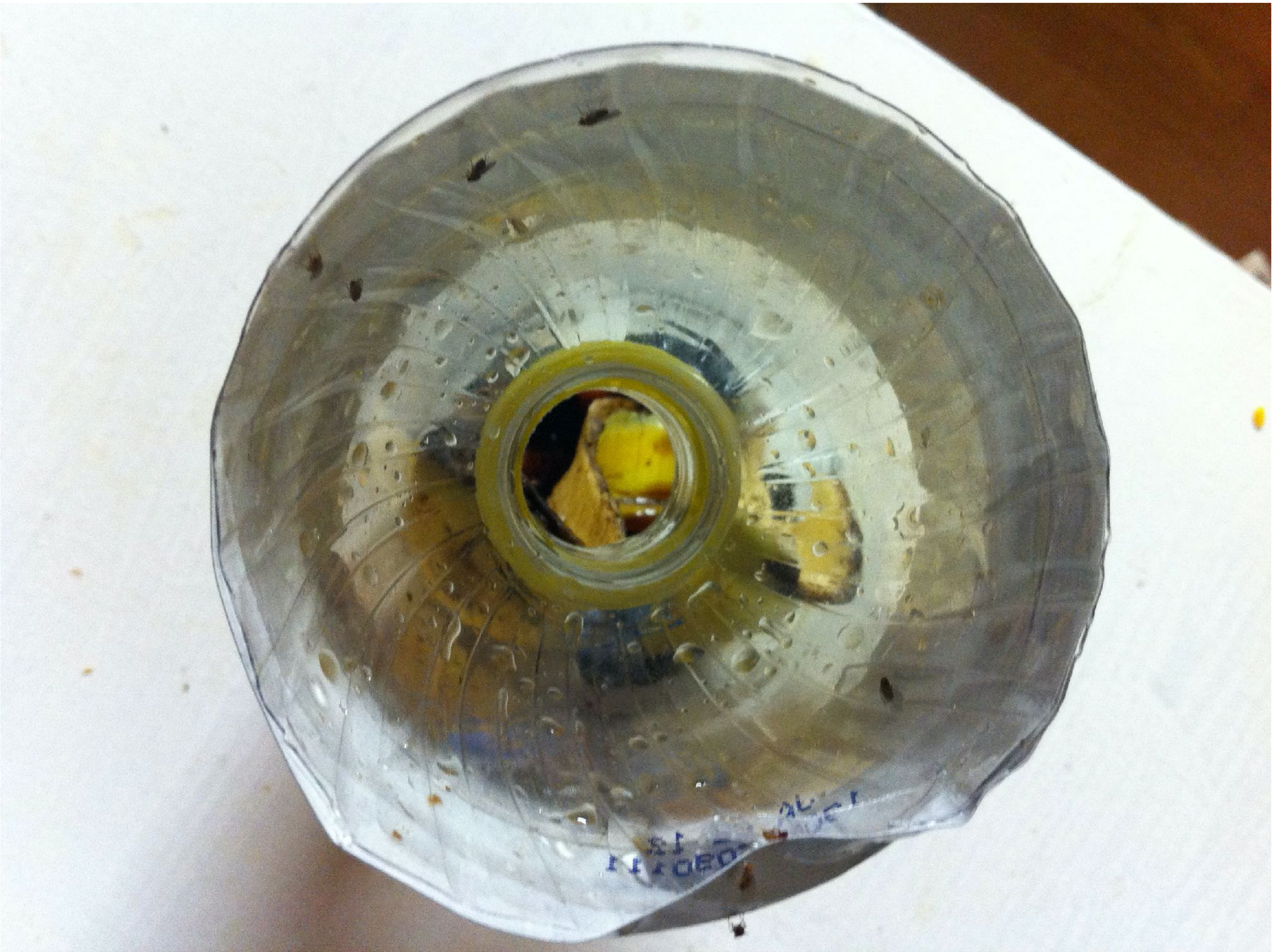
Monitor | Tools of the trade

Pheromone Traps | Sweet potato weevil

Juliana Cardona-Duque, University of Puerto Rico, Bugwood.org

Monitor | Tools of the trade

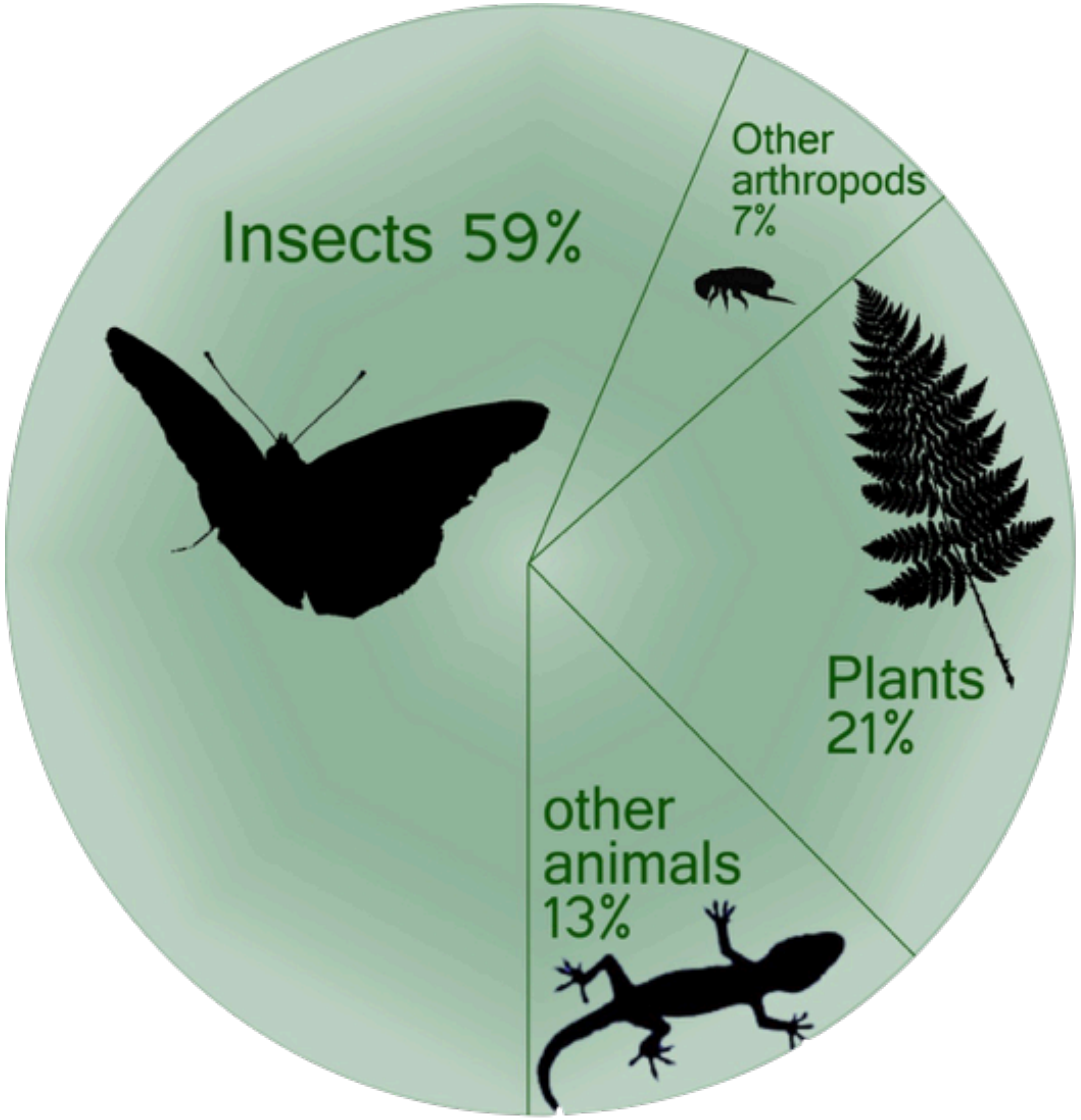
General Lures/Traps



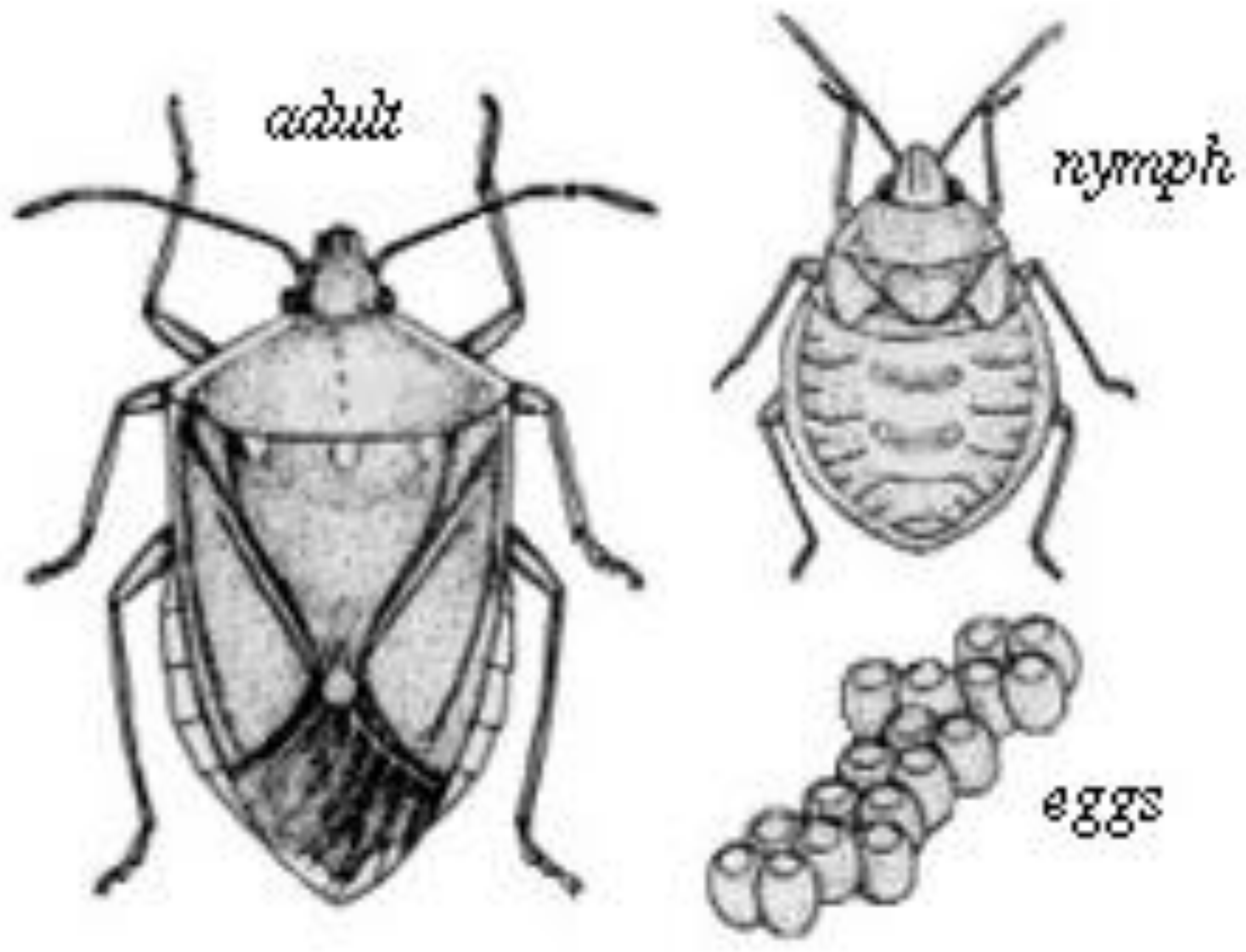
Insect Identification

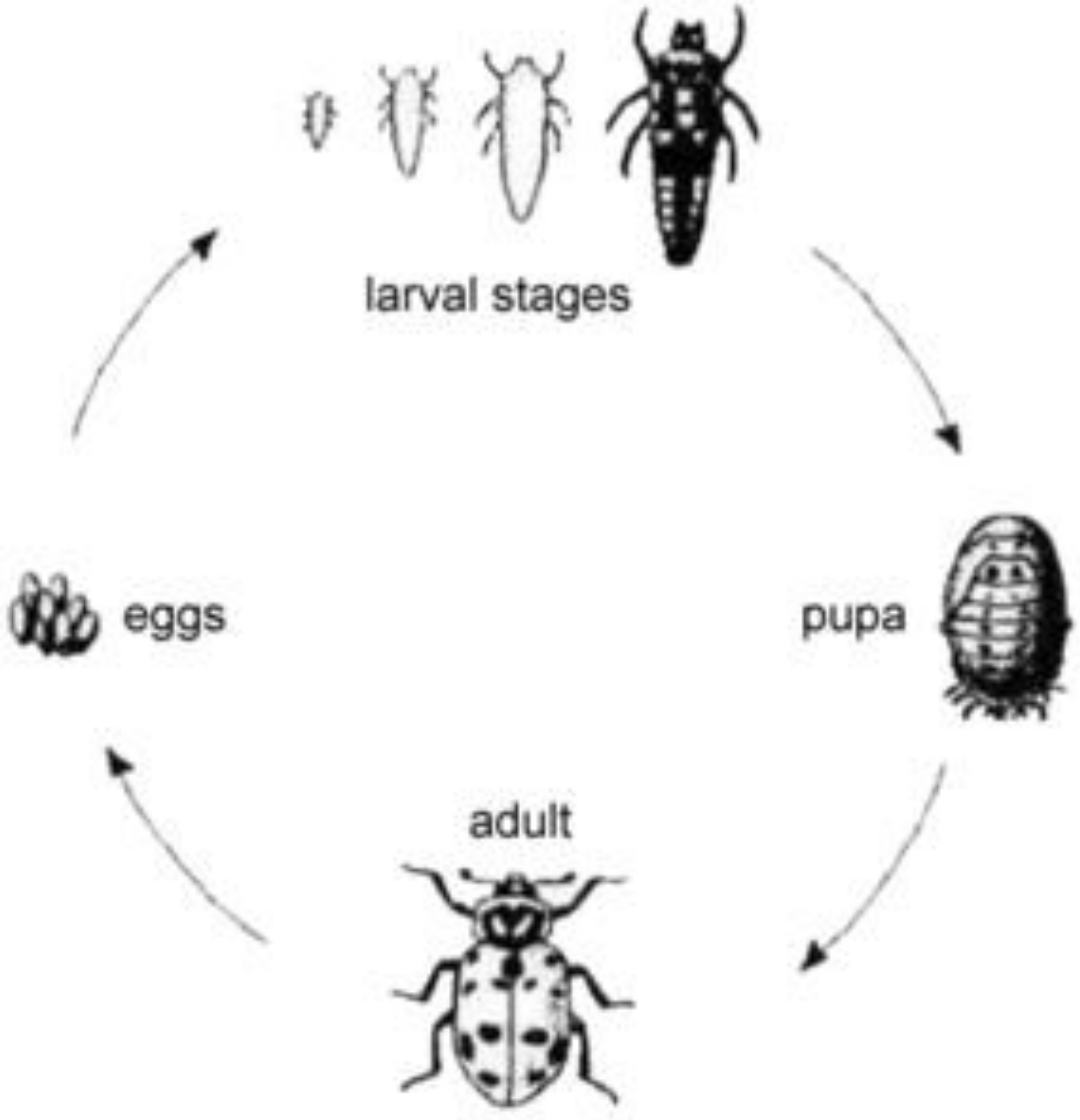
- Recent estimates of species diversity
- Total estimated species count: 8.7 million (Eukaryotes)
- 2.2 million marine
- 1.2 million species described

- 86% of existing species undescribed (96% of marine species)
- (Mora et al. 2011)



Larva

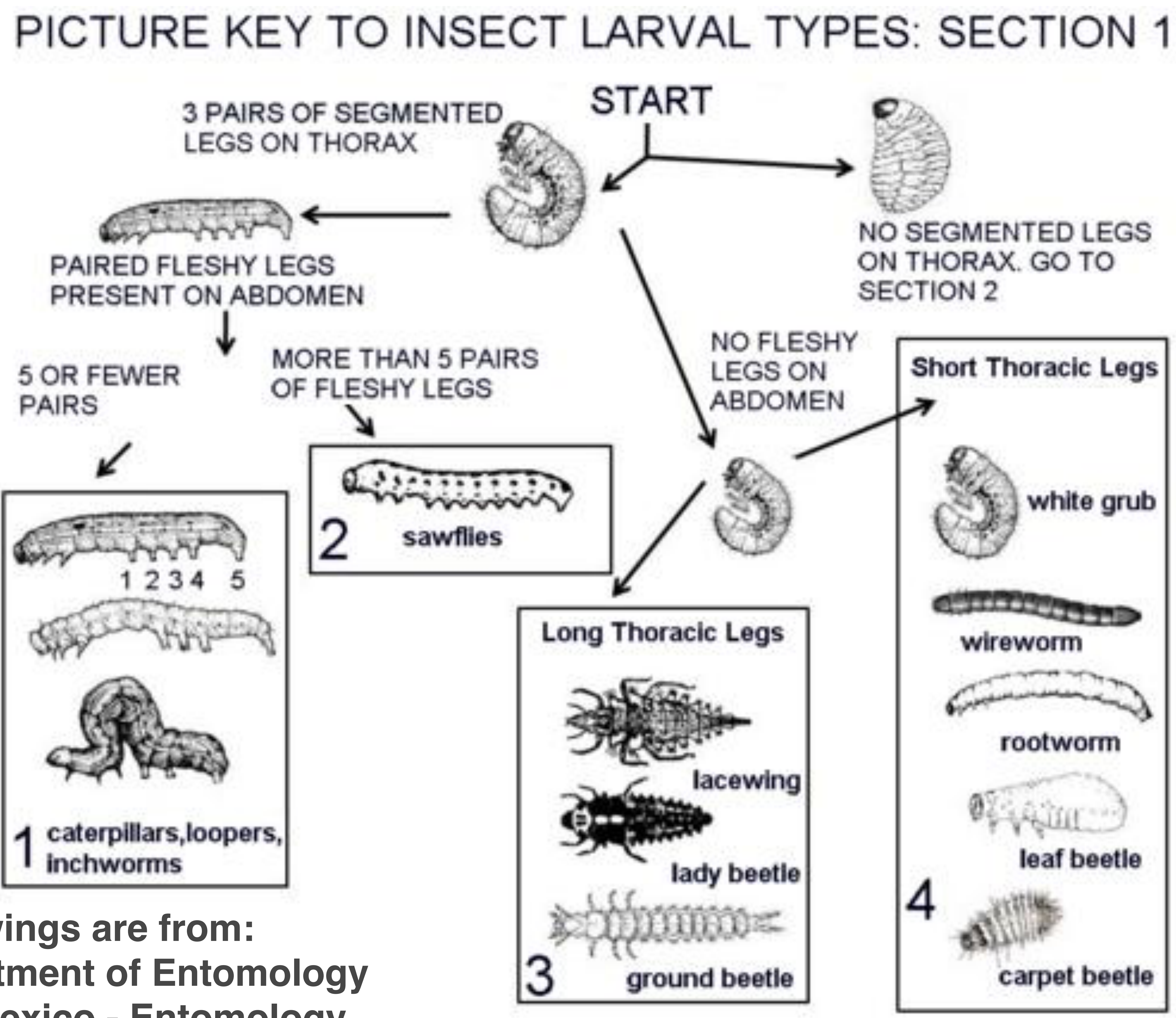




Life cycle drawings are from:
Virginia Tech - Department of Entomology
University of New Mexico - Entomology

Lee Townsend, Extension Entomologist, University of Kentucky College of Agriculture

Larva



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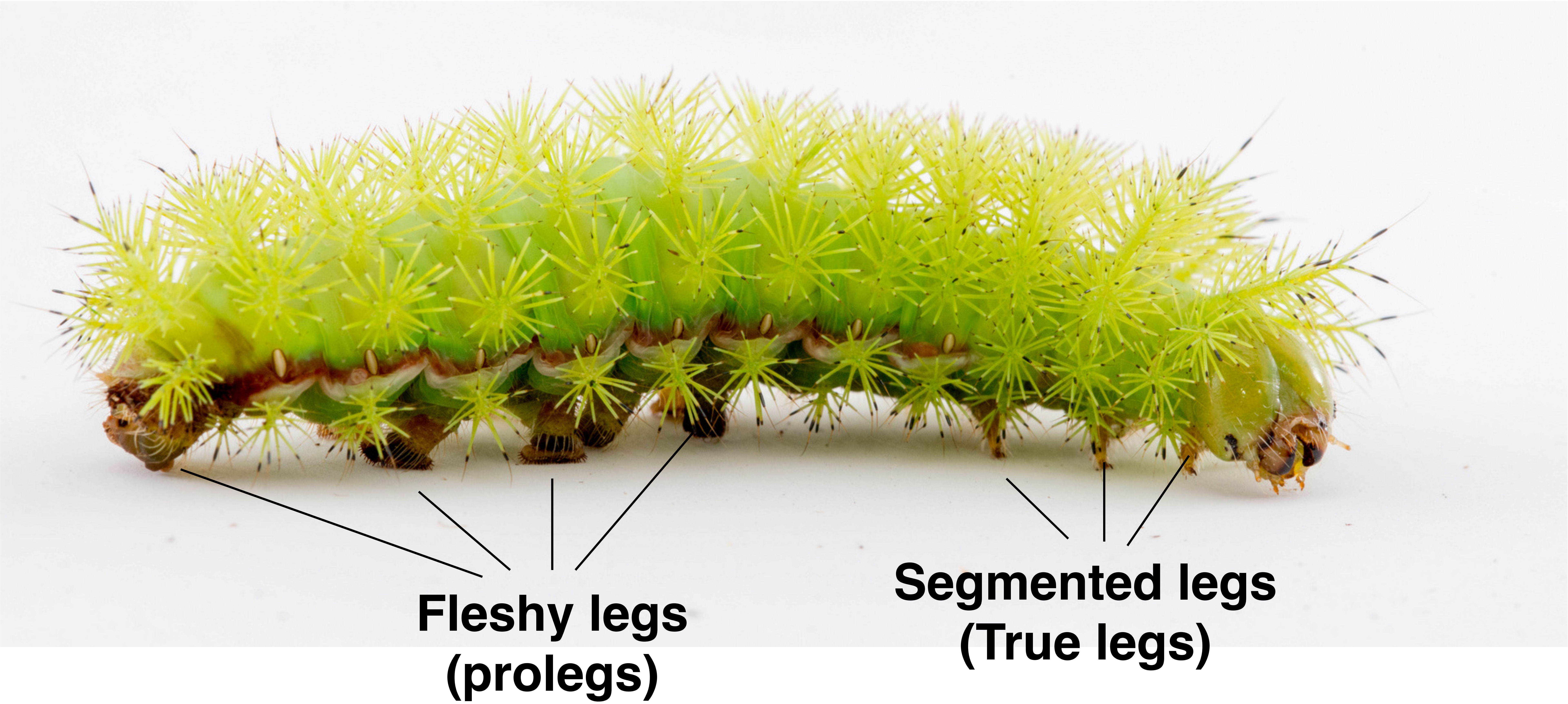
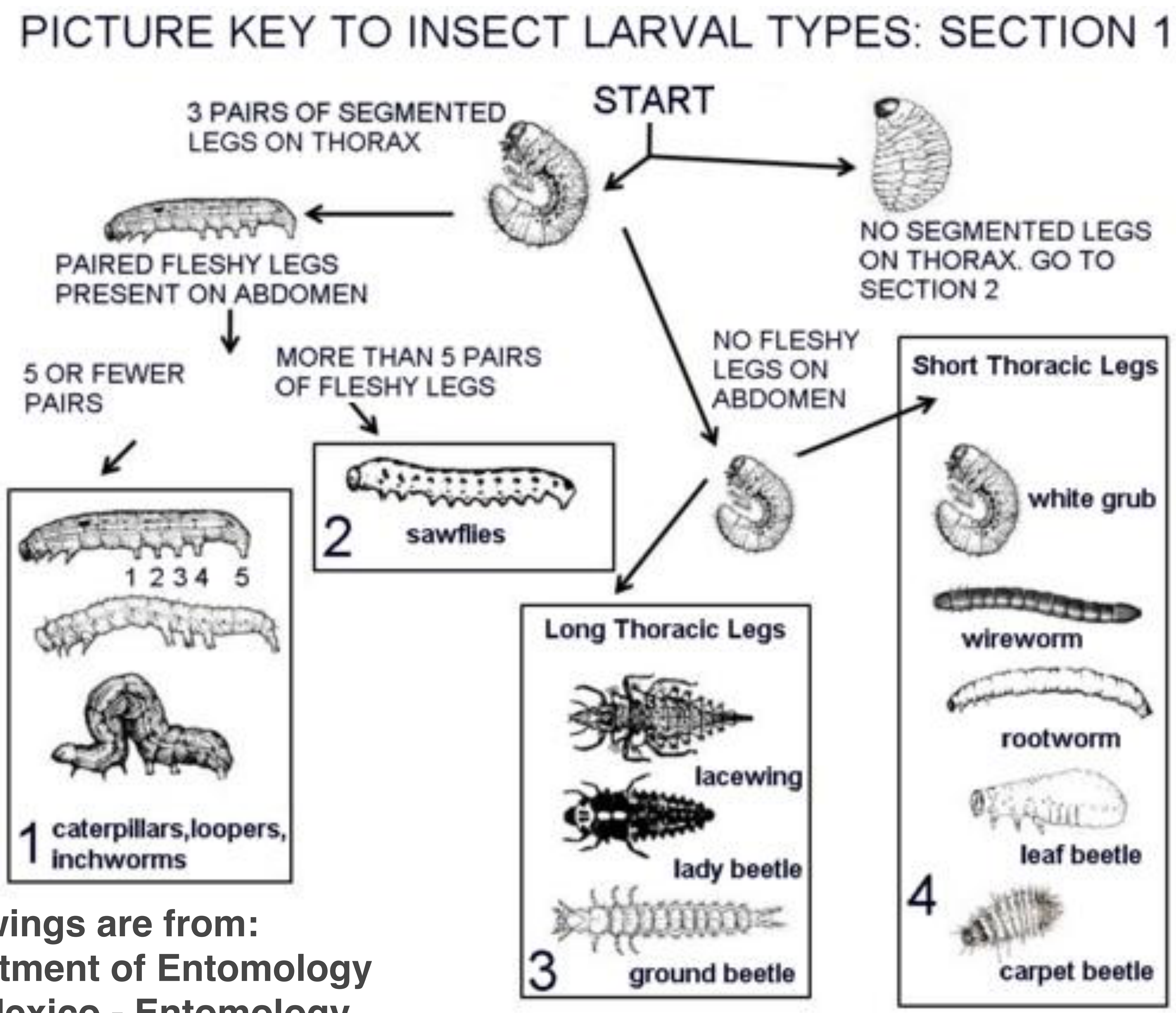


Io moth caterpillar, *Automeris io* (Erfan Vafaie, Texas A&M AgriLife Extension)

Larva



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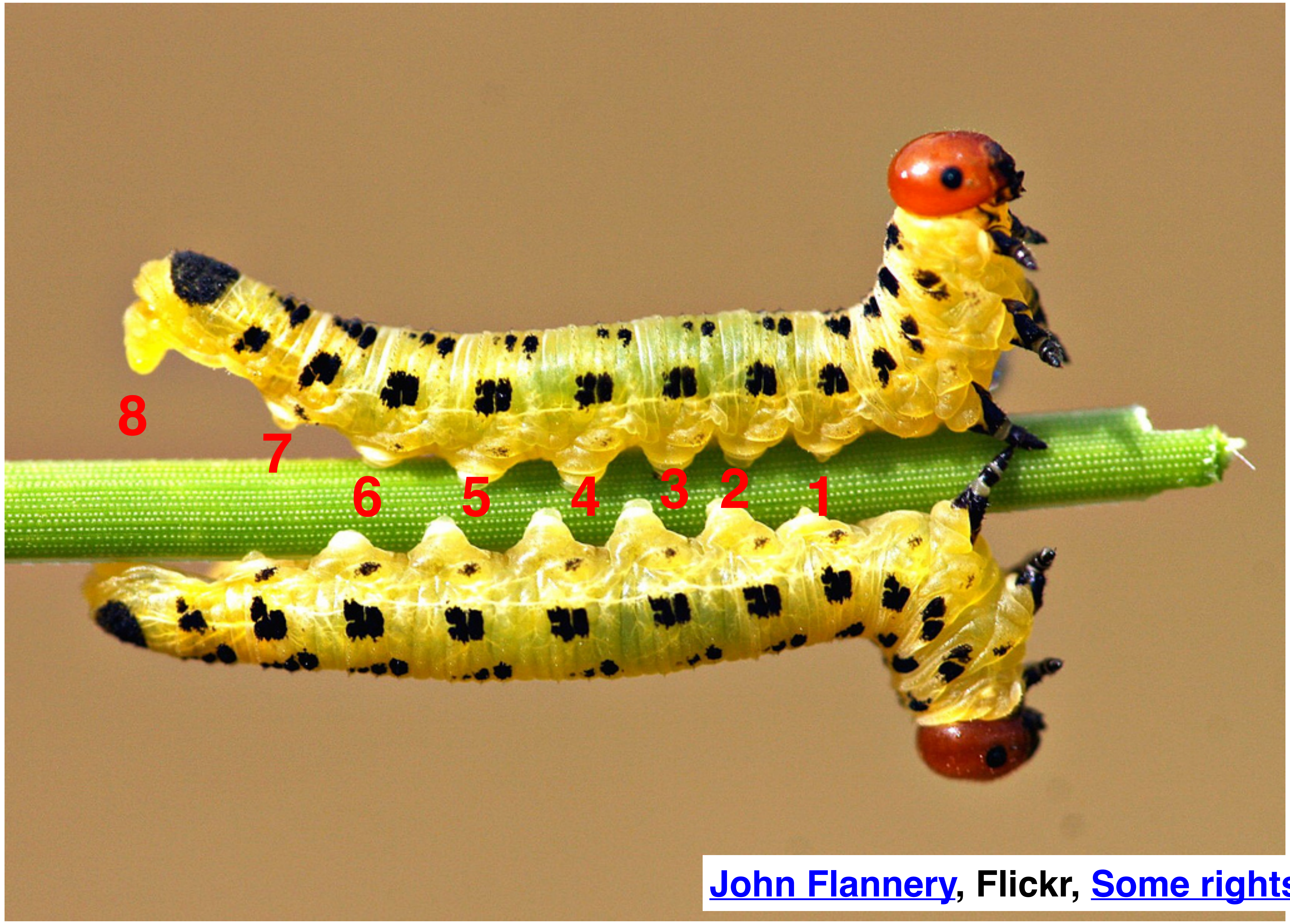
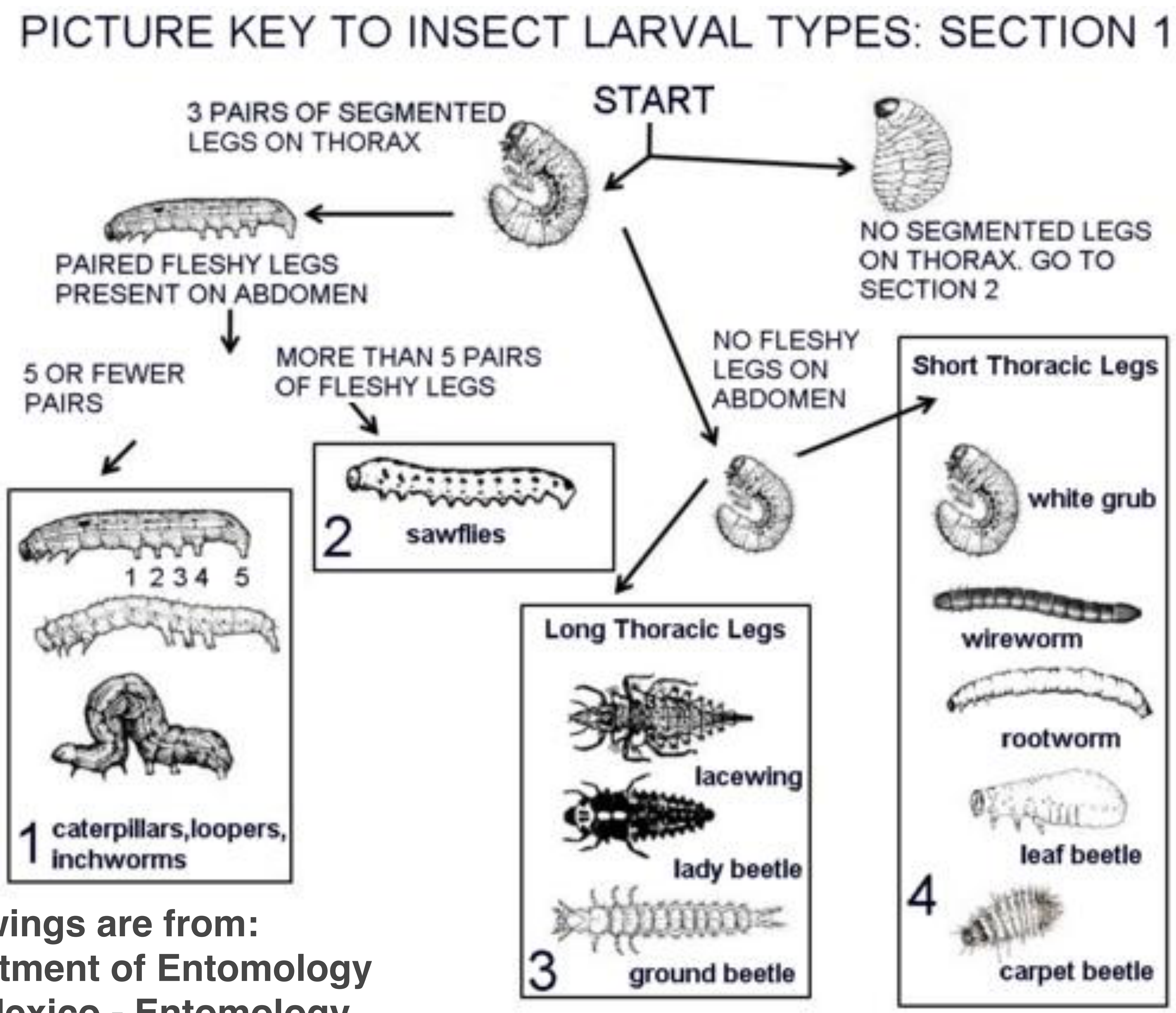
Larva



Sawfly, Family: Symphyta

Larva



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University of New Mexico - Entomology

Lee Townsend, Extension Entomologist, University of Kentucky College of Agriculture

Larva

Derek Parker, Flickr, Some rights reserved

Lady beetle larva, Family: Coccinellidae

Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Larva

AJ Cann, Flickr, Some rights reserved

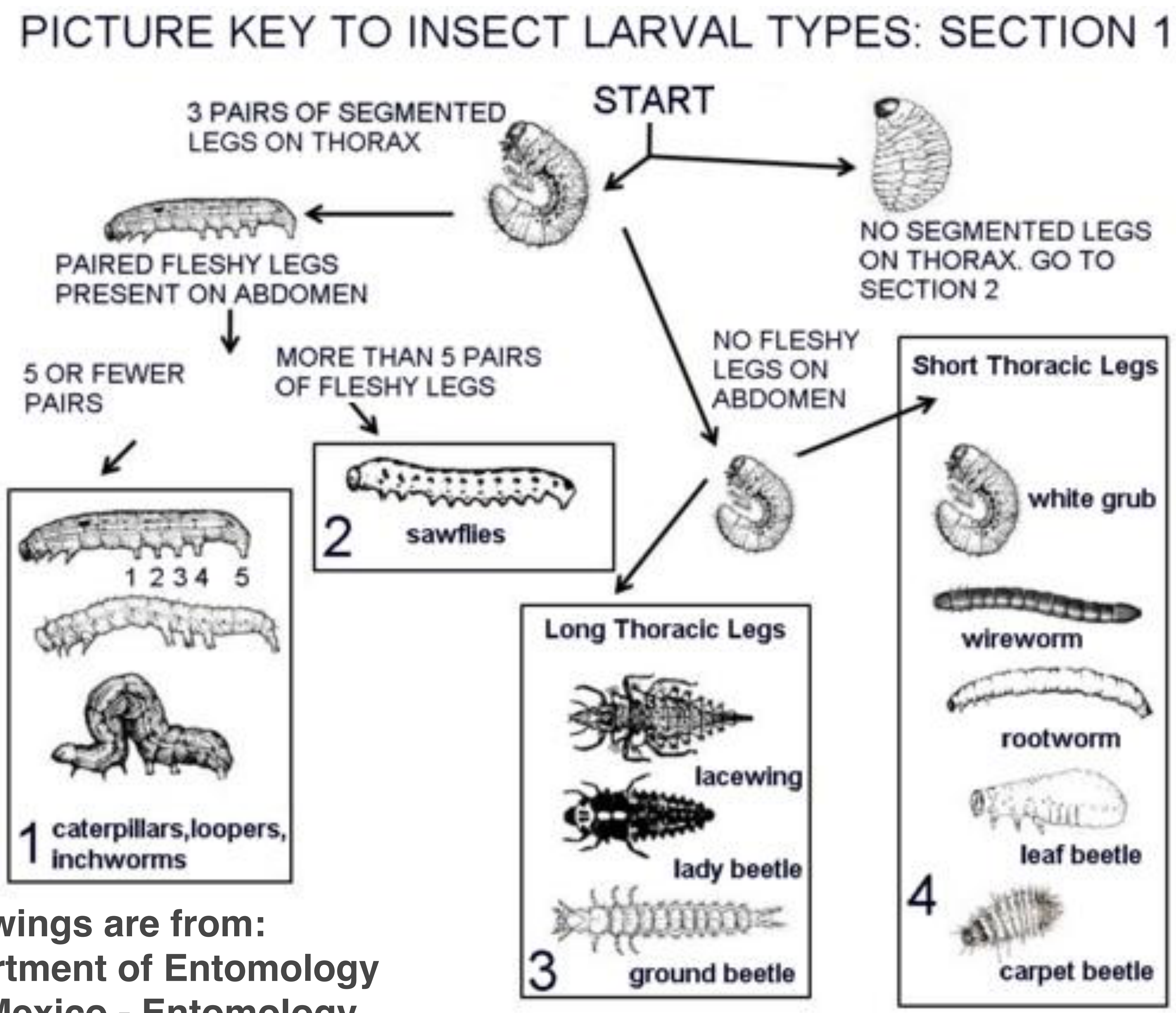
Ground beetle larva, Family: Carabidae

Larva

Katja Shultz, Flickr, Some rights reserved

Ground beetle adult, Family: Carabidae

Larva



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Virginia Tech - Department of Entomology
University of New Mexico - Entomology

Lee Townsend, Extension Entomologist, University of Kentucky College of Agriculture

Larva

David Cappaert, Bugwood.org

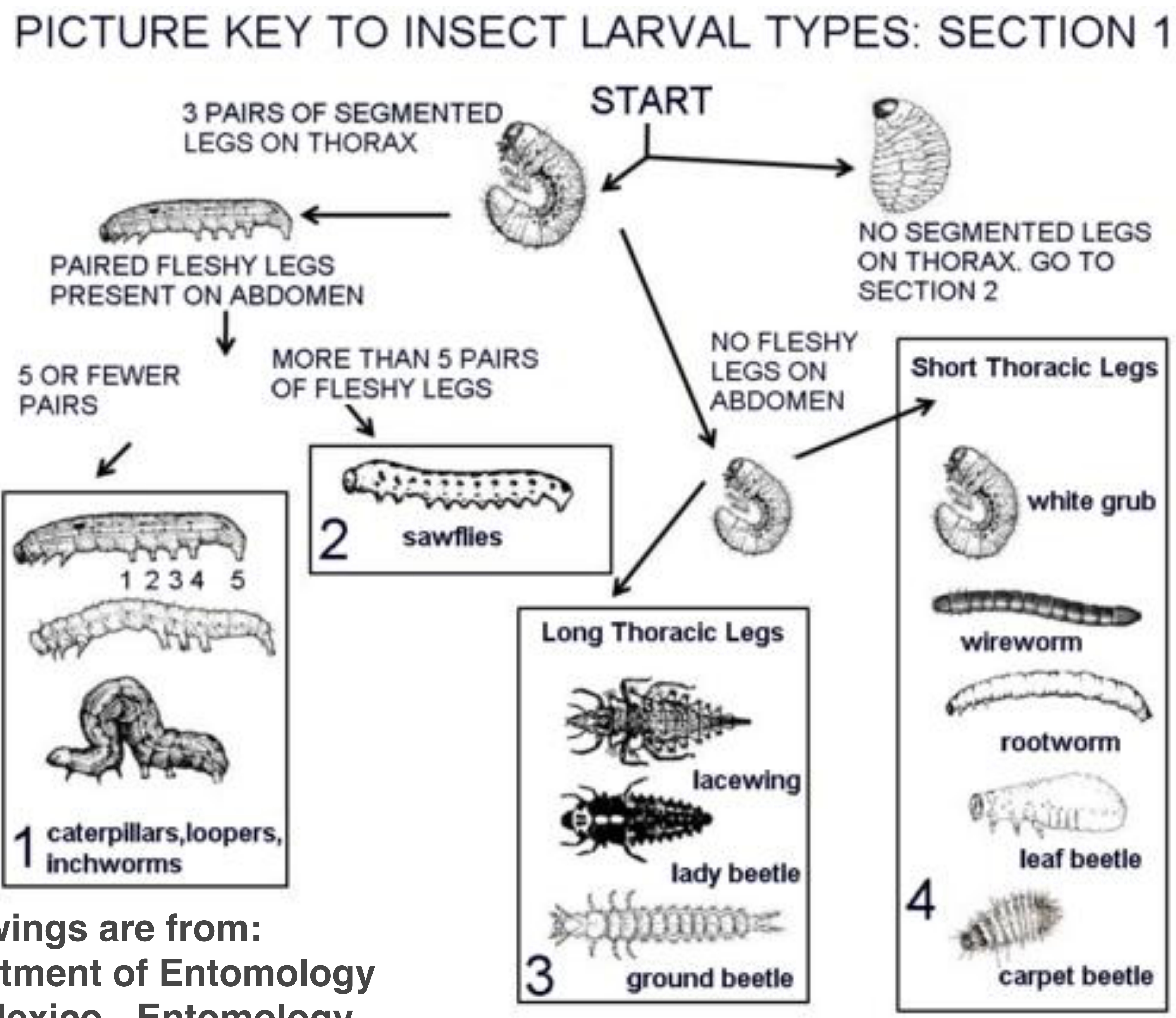
White grubs, Family: Scarabaeidae

Larva

Clemson University – USDA Cooperative Extension Slide Series, Bugwood.org

Tobacco wireworm, *Conoderus vespertinus*

Larva



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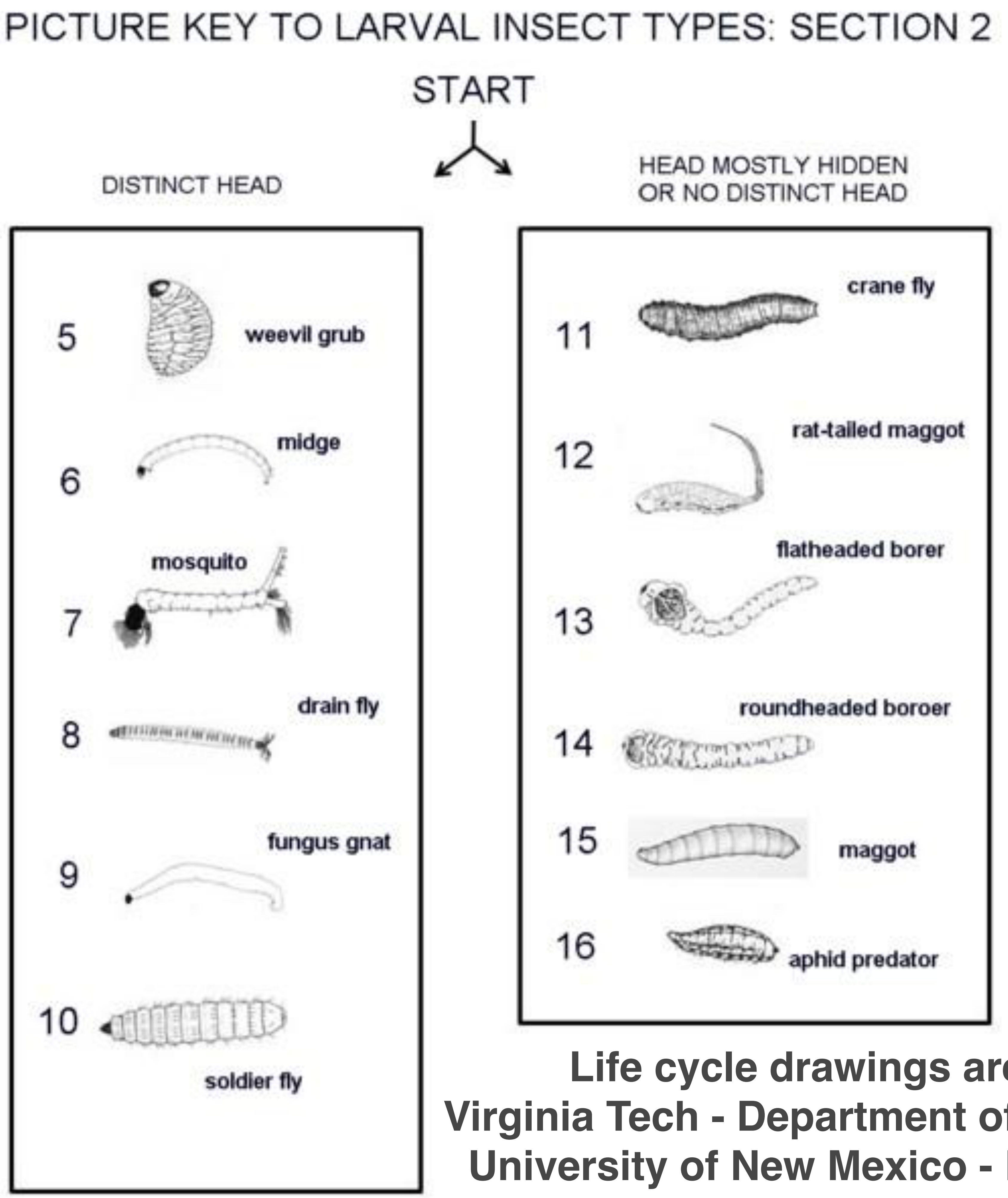
Larva



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University of New Mexico - Entomology

Lee Townsend, Extension Entomologist, University of Kentucky College of Agriculture

Larva

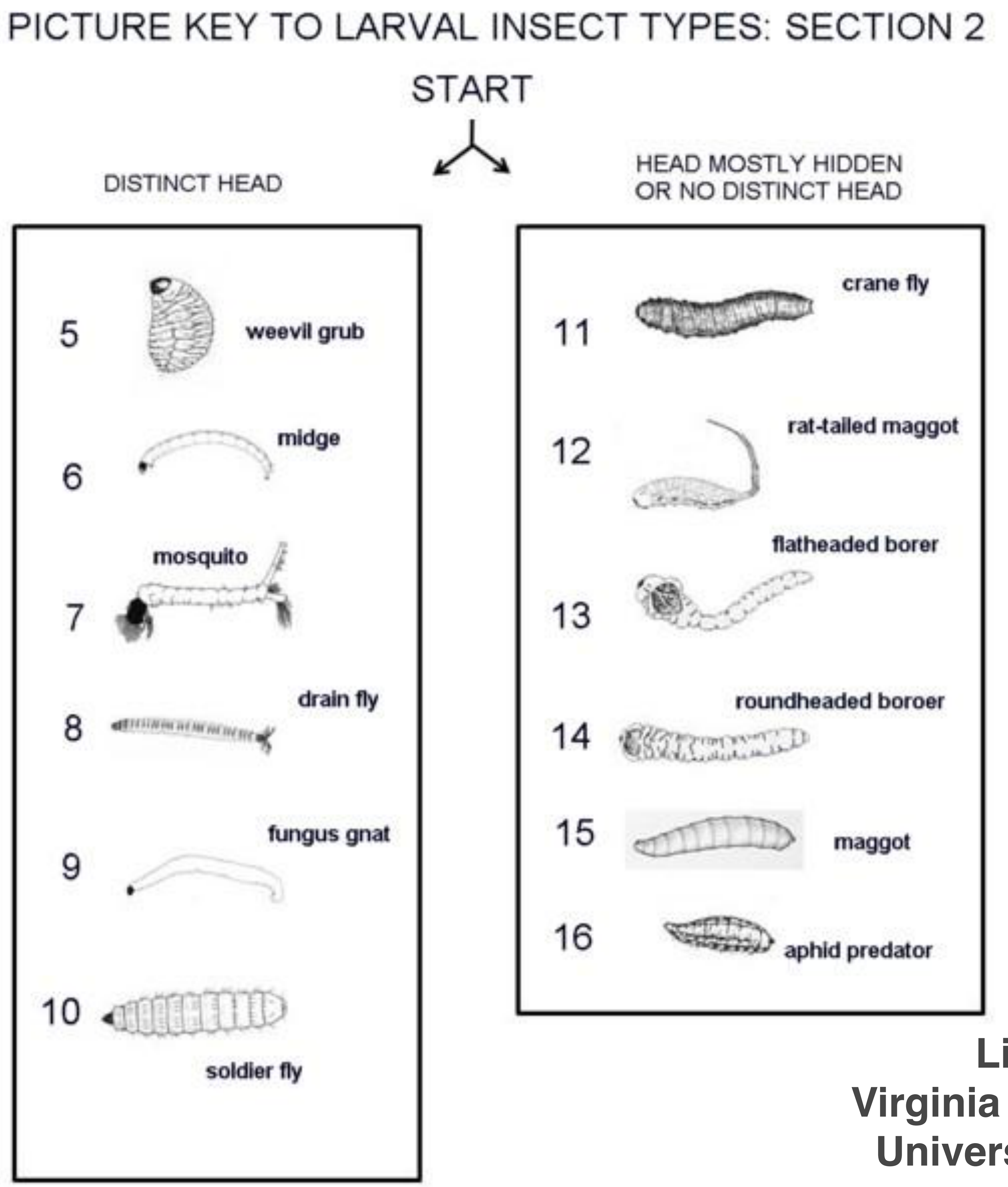
David Cappaert, Bugwood.org

Darkwinged fungus gnat larva, *Bradysia sp.*

Larva

Pitch-eating weevil, *Pachylobius picivorus*

Larva



Life cycle drawings are from:
Virginia Tech - Department of Entomology
University of New Mexico - Entomology

Larva

John C. French Sr., Retired, Universities:Auburn, GA, Clemson and U of MO, Bugwood.org

House fly, *Musca domestica*

Larva

Andrew Hoffman, Flickr, Some rights reserved

Crane fly larva, Family: Tipulidae

Texas A&M AgriLife Extension

Thrips


Greenhouse thrips

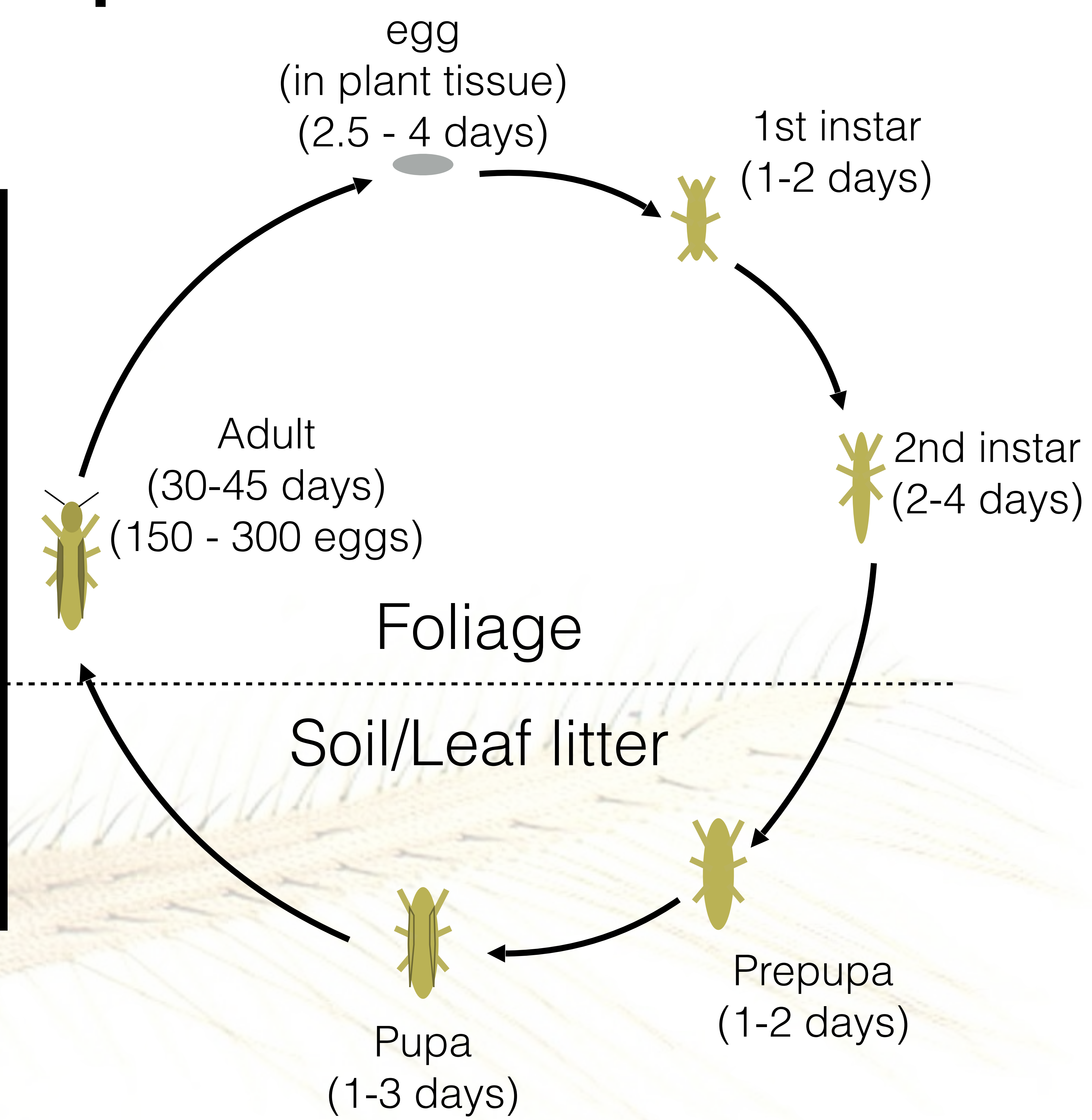

Adult western flower thrips

Chili Thrips

UGA0019008

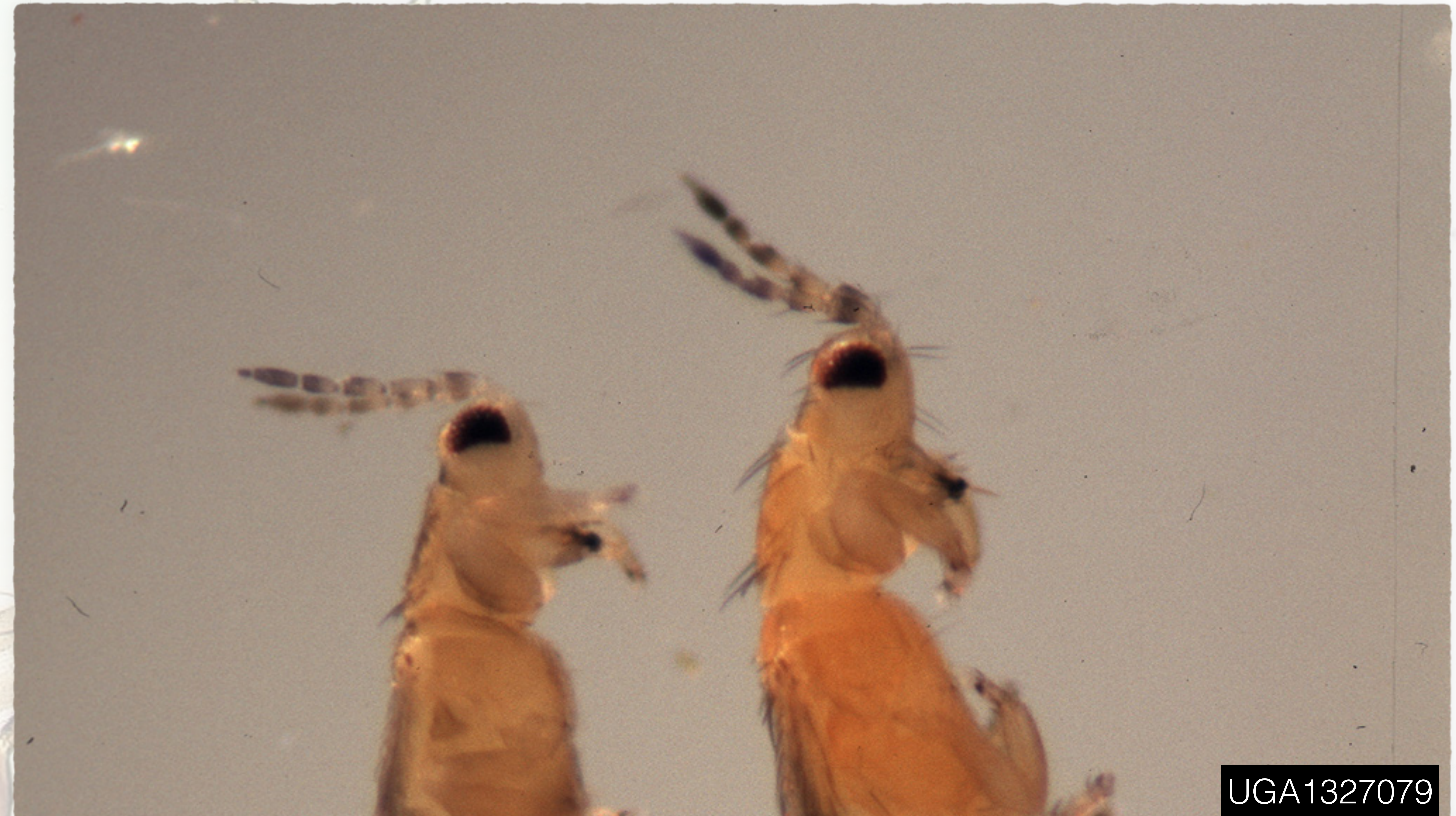
Texas A&M AgriLife Extension

Thrips

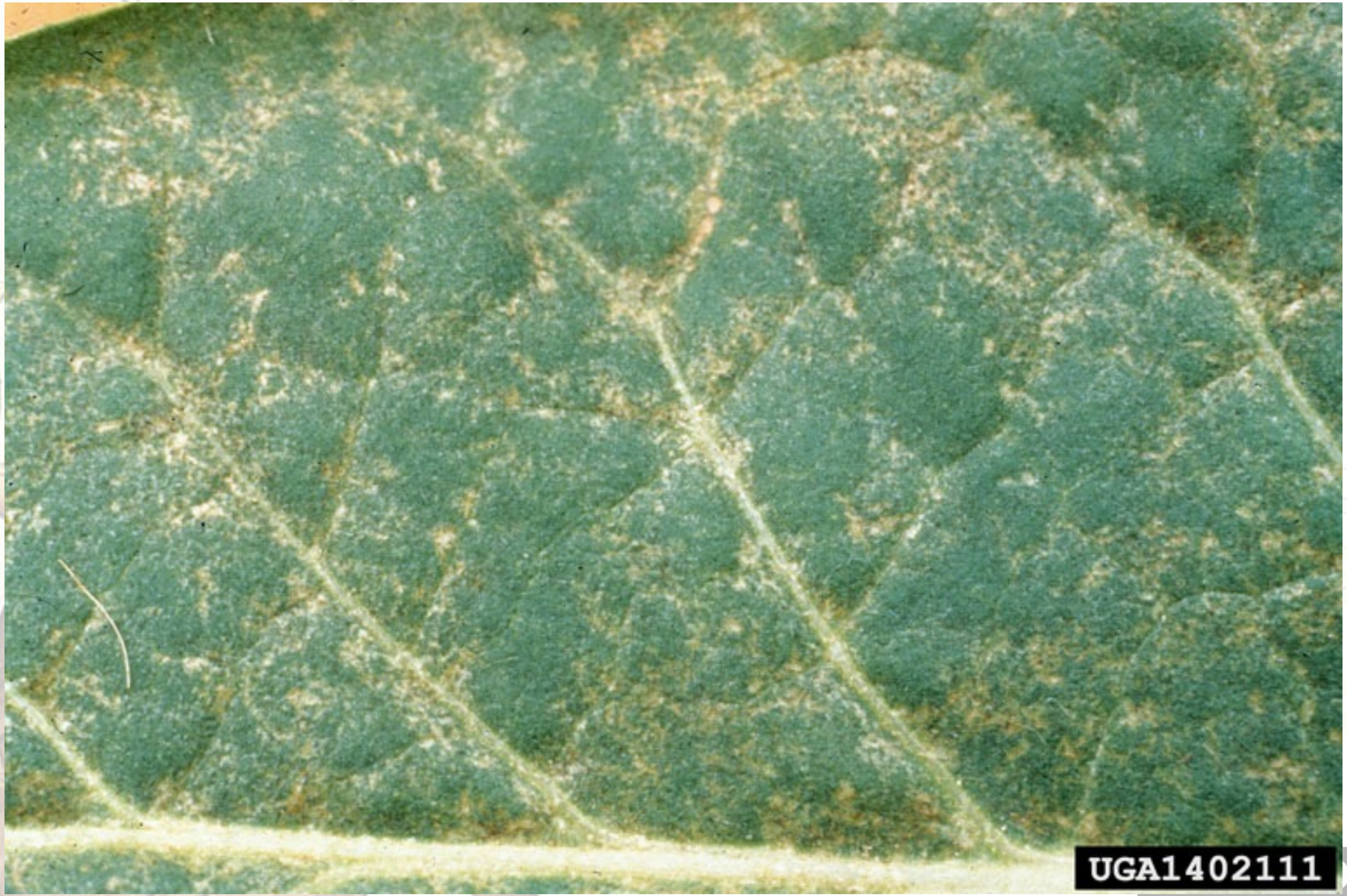


UGA0019008

Thrips



Thrips



Thrips

Thrips

Thrips

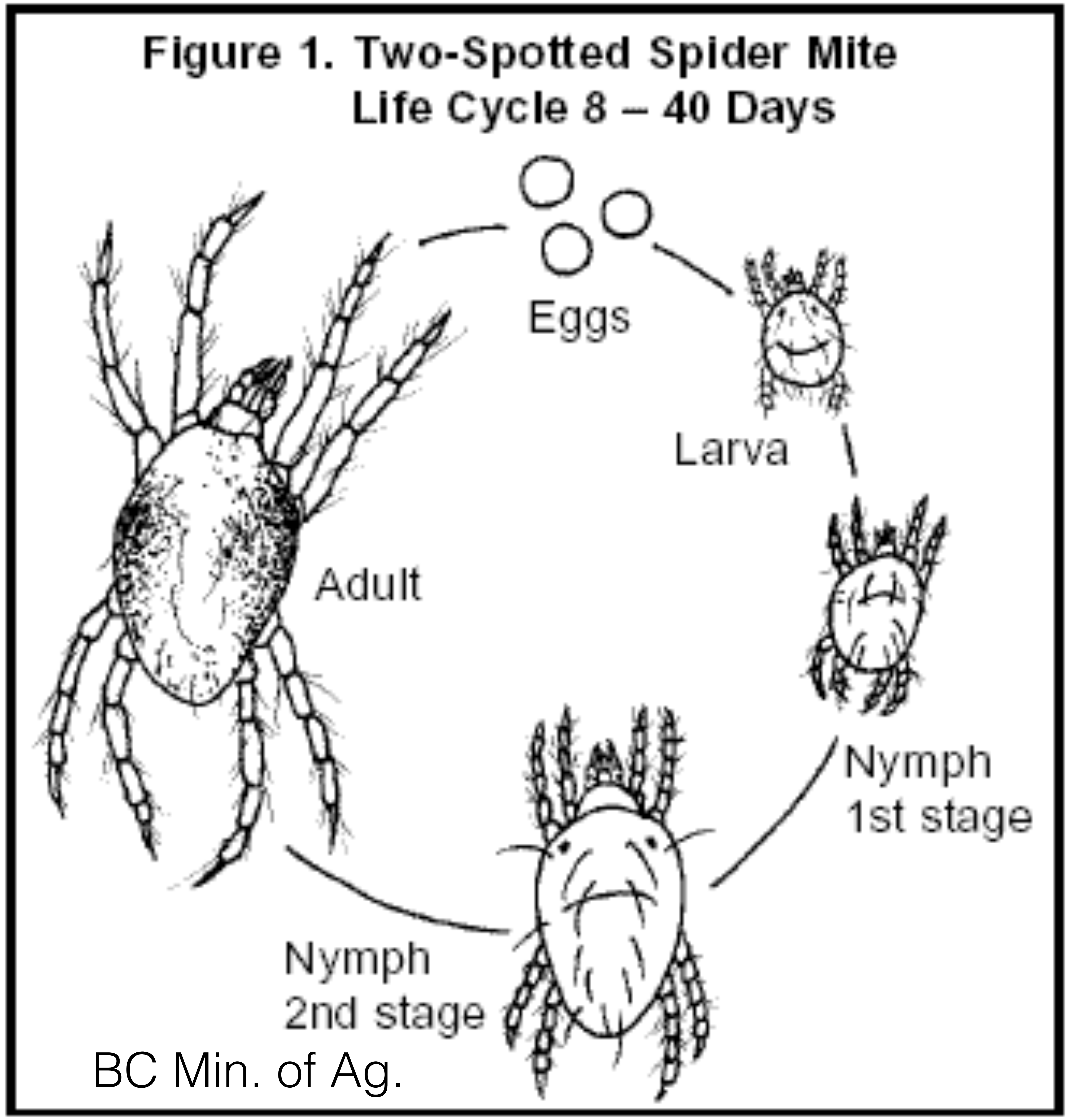
Oak Tatters

Erfan Vafaie, Texas A&M AgriLife Extension Service, bugwood.org

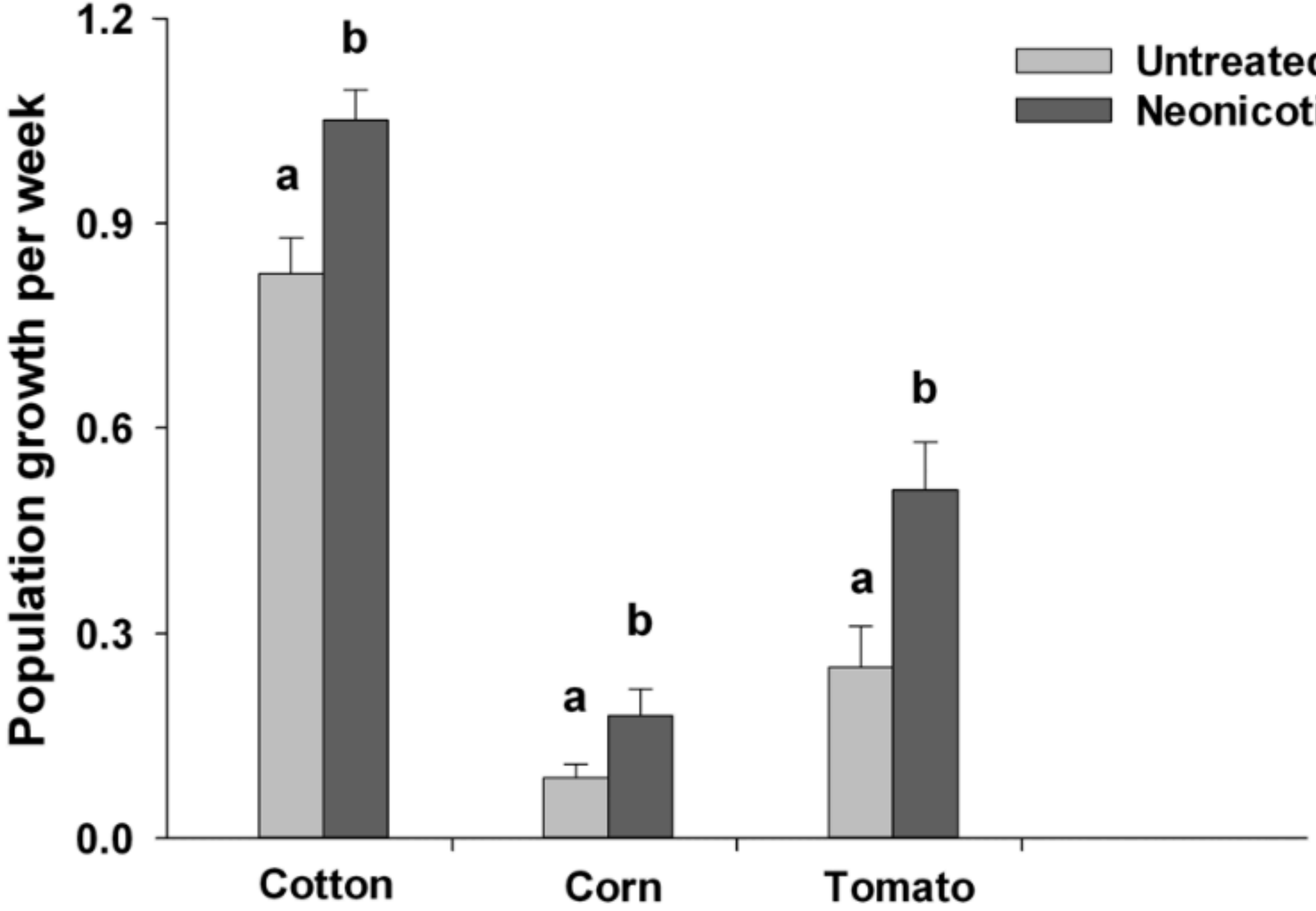
Twospotted spider mites

Twospotted spider mites

Twospotted spider mites



Twospotted spider mites | Pesticides



Twospotted spider mites | Fertilizer

Horticultural Entomology

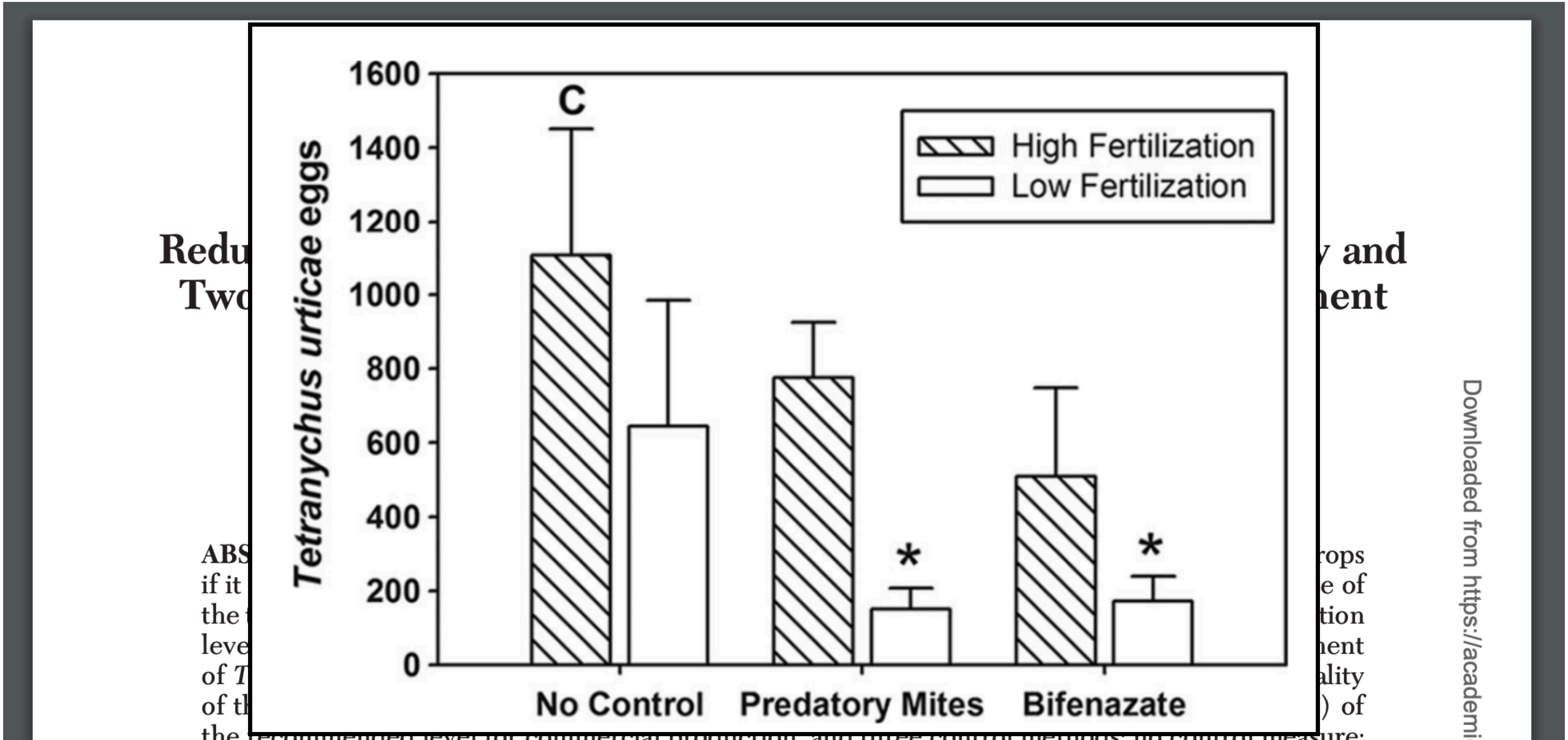
Reducing Fertilization for Cut Roses: Effect on Crop Productivity and Twospotted Spider Mite Abundance, Distribution, and Management

ANDREW CHOW,[1,2] AMANDA CHAU,[1,3] AND KEVIN M. HEINZ[1]

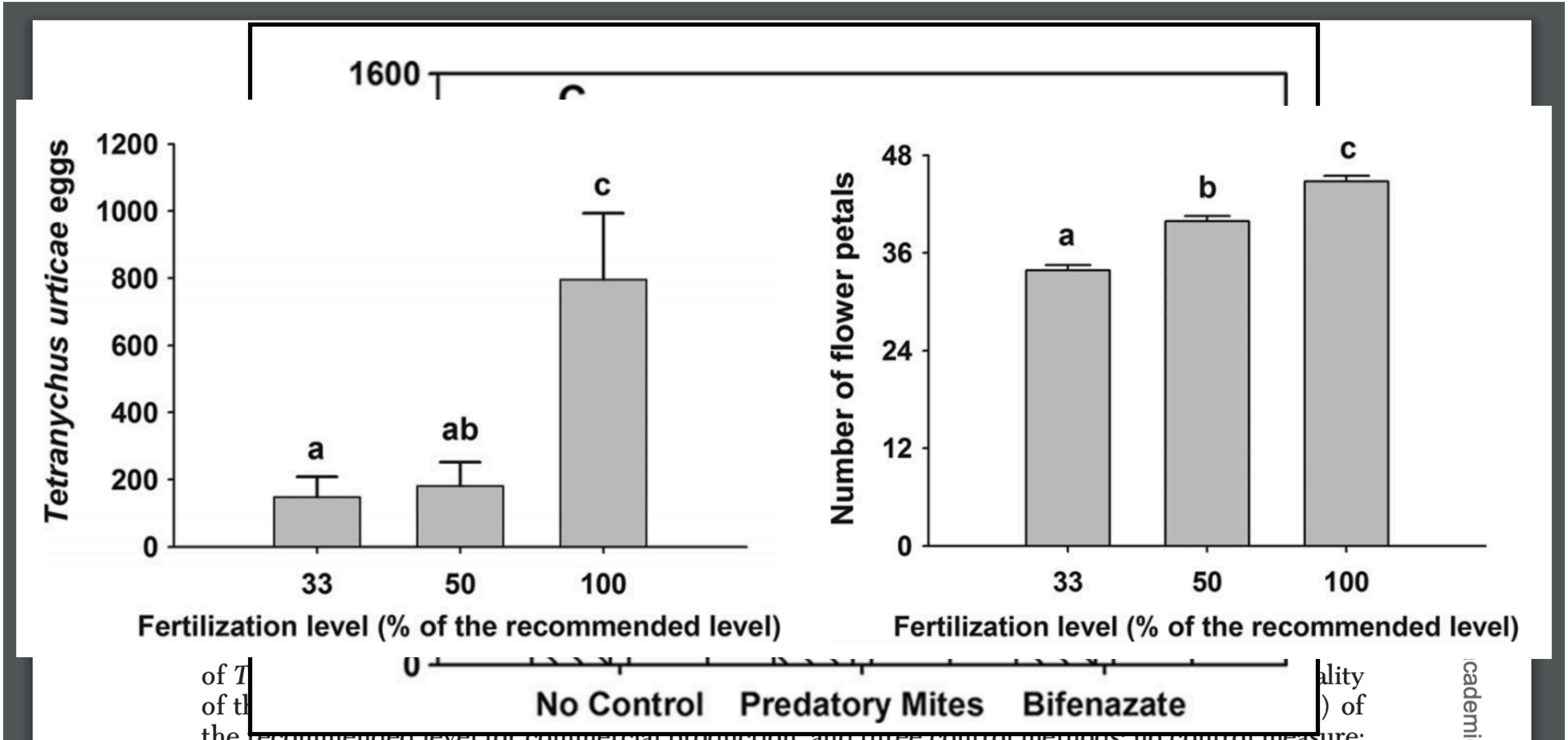
J. Econ. Entomol. 102(5): 1896–1907 (2009)

ABSTRACT Fertilization reduction could be a useful pest management tactic for floriculture crops if it reduced pest populations with little loss in crop yield and quality. We evaluated the response of the twospotted spider mite, *Tetranychus urticae* Koch (Acari: Tetranychidae), to different fertilization levels for cut roses, *Rosa hybrida* L. 'Tropicana' and quantified fertilization effects on 1) management of *T. urticae* on roses, 2) abundance and distribution of *T. urticae* on roses, and 3) yield and quality of the cut rose crop. We tested two fertilization levels, 10% (15 ppm N) and 100% (150 ppm N) of the recommended level for commercial production, and three control methods; no control measure;

Twospotted spider mites | Fertilizer



Twospotted spider mites | Fertilizer



Caterpillars

Caterpillars

Texas A&M AgriLife Extension

Caterpillars

Caterpillars


Photo Cred: Allen Knutson & Mike Merchant

Caterpillars

Caterpillars

Caterpillars


Photo Cred: Daily Mail


Steven Katovich, USDA Forest Service, Bugwood.org


Vafaie 2015

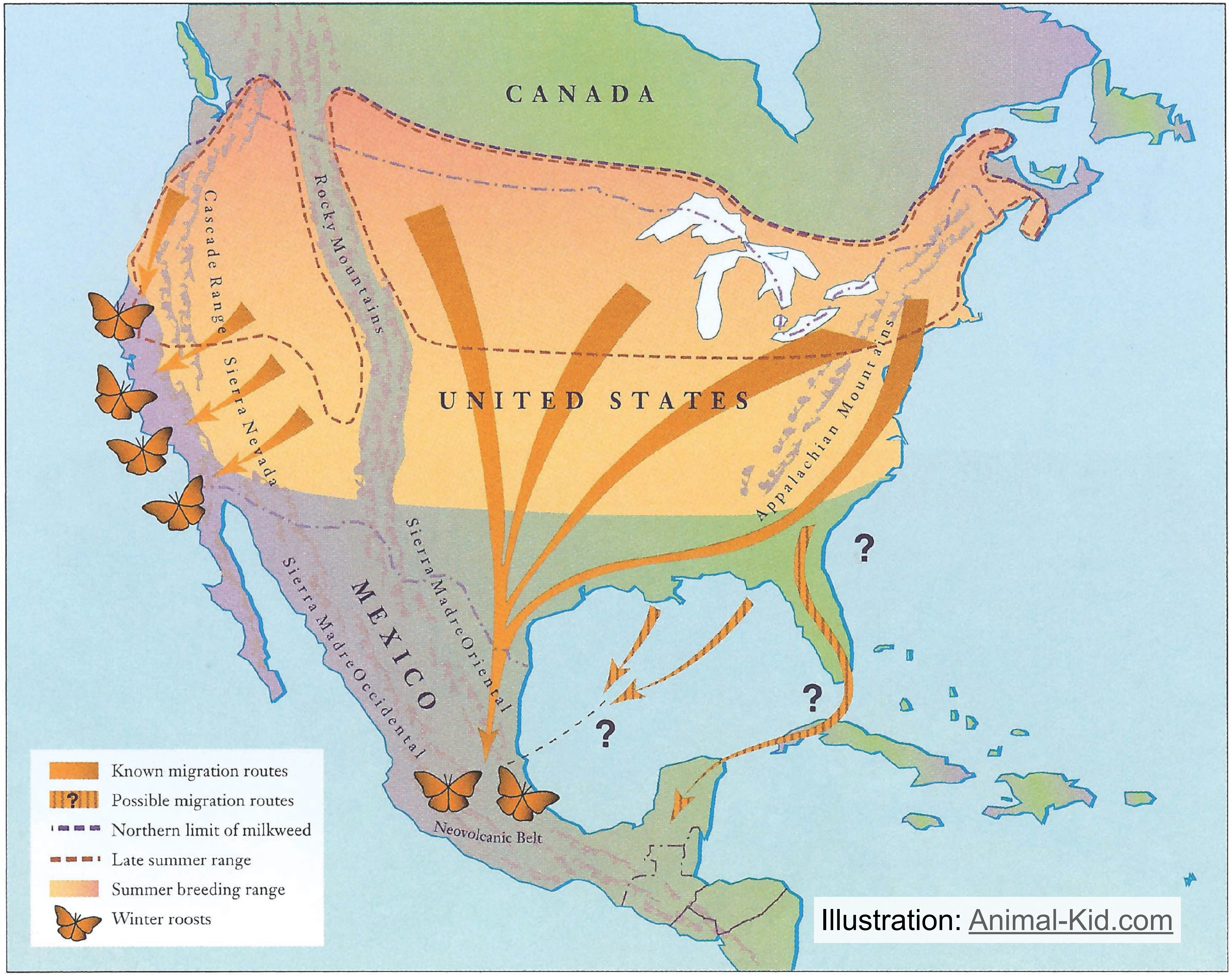


Illustration: Animal-Kid.com

Whiteflies & Aphids

Honeydew

Sooty mold

TEXAS A&M AGRILIFE EXTENSION

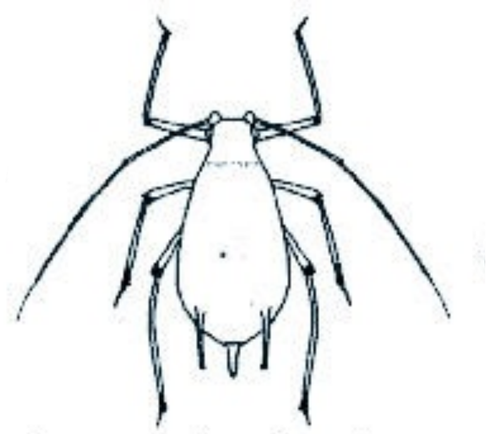

I
Pupa
II
Eggs
III
Adult
IV

Whiteflies & Aphids

Whiteflies & Aphids

Overwinter

Short daylength
Cooler temperature
Degrading habitat



Asexual wingless female

Illustration from Mauro Mandrioli

Green Lacewing Adult

Judy Gallagher, Flickr, Some rights reserved


Lacewing larva


Leaffooted bugs

Leaffooted bugs

Adult *Leptoglossus zonatus*

Adult *Leptoglossus occidentalis*

Adult *Leptoglossus clypealis*


Leaffooted bugs

Not to be confused with…


Wheel bug

Crapemyrtle bark scale

North Amer. First sighting:
2004, Northern Texas

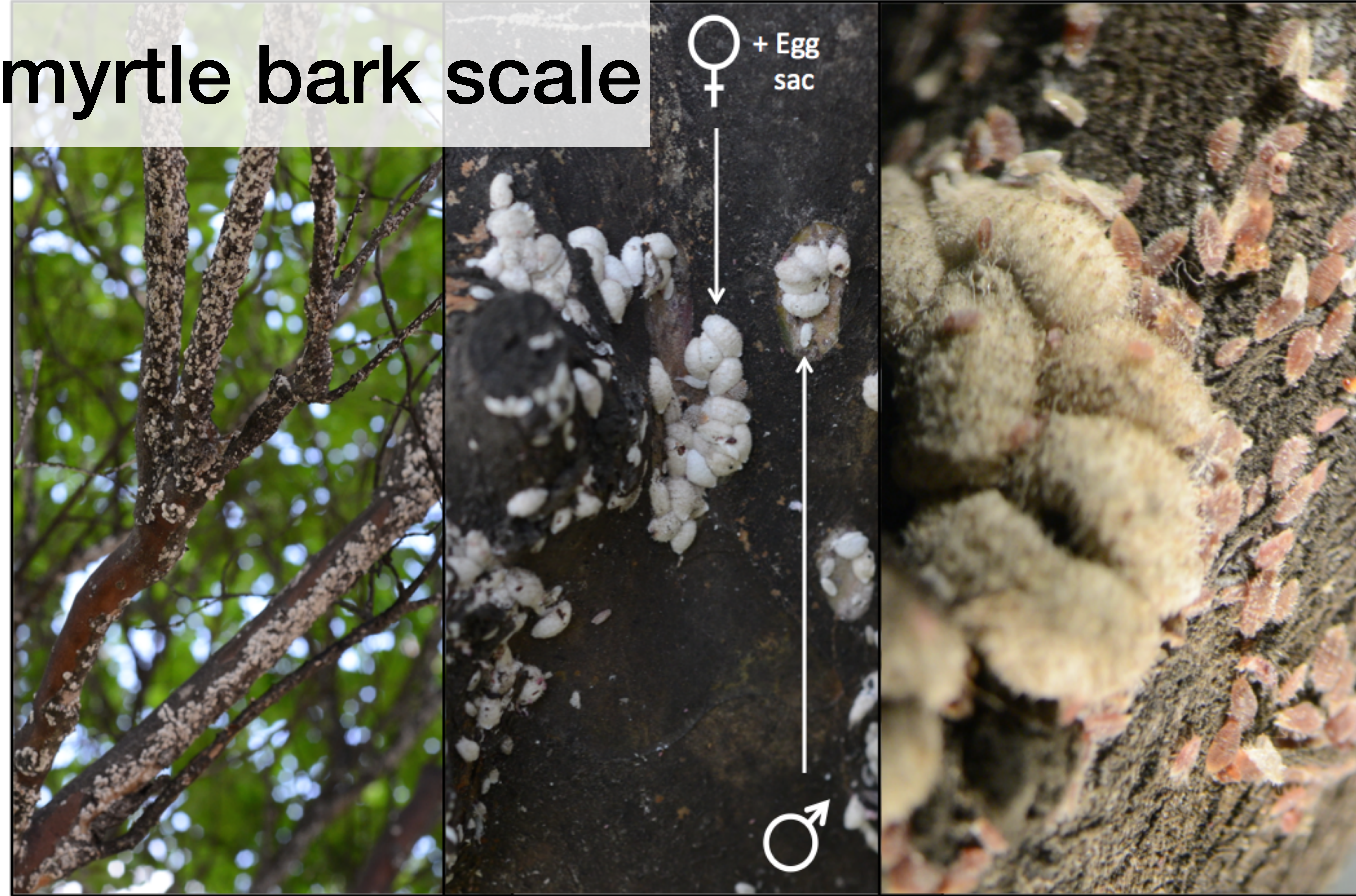
Now found in:
TX, OK, LA, AR, NM, TN, GA, AL, MS, NC, SC, VA, and WA

Originally from:
Asia
[*Acanthococcus lagerstroemiae* (Hemiptera: Eriococcidae]

Crapemyrtle bark scale

Crapemyrtle bark scale

Crapemyrtle bark scale



Crapemyrtle bark scale | Nymph (2nd instar)

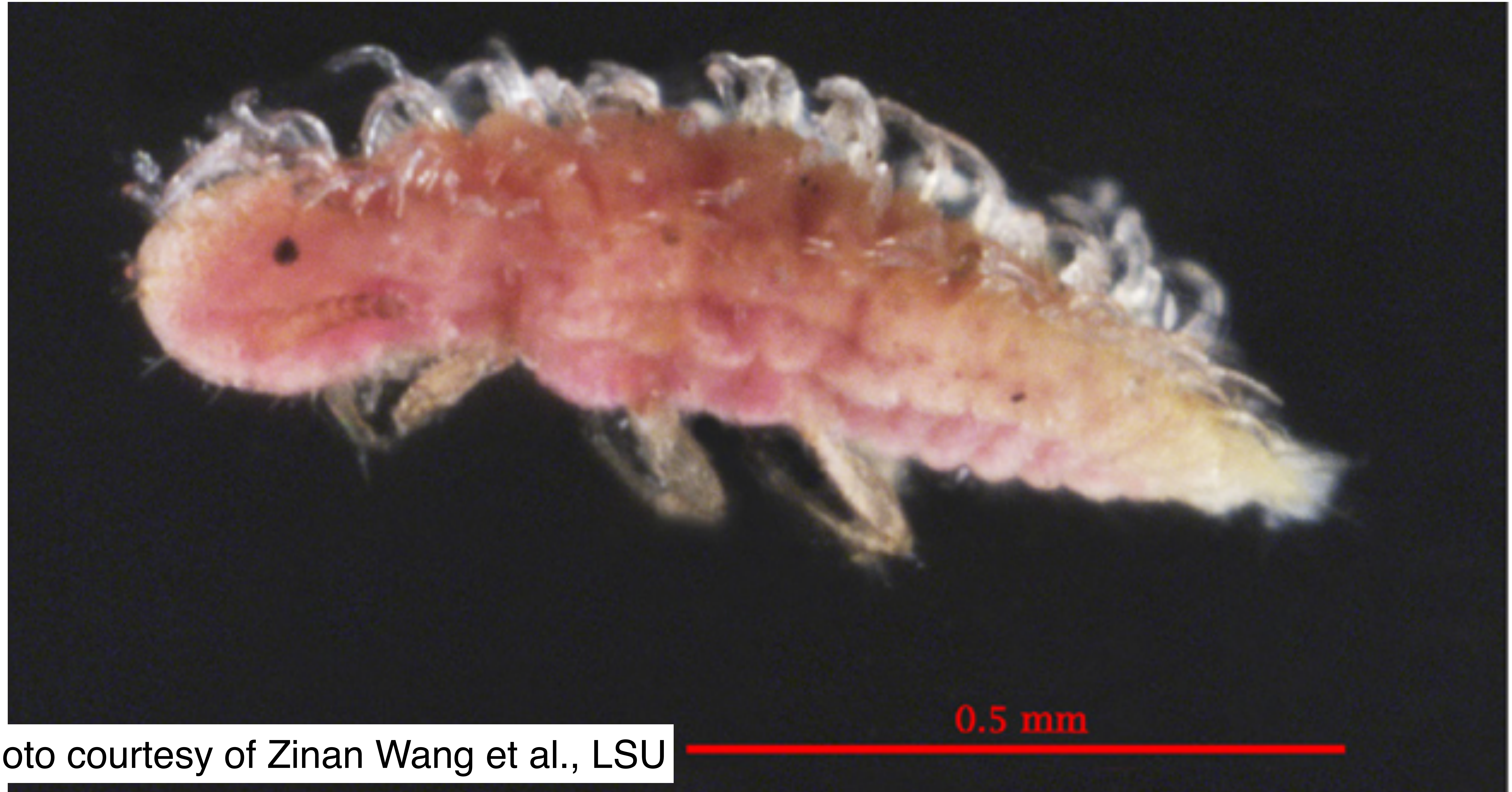


Photo courtesy of Zinan Wang et al., LSU

Crapemyrtle bark scale

Crapemyrtle bark scale

Crapemyrtle bark scale | Male adult

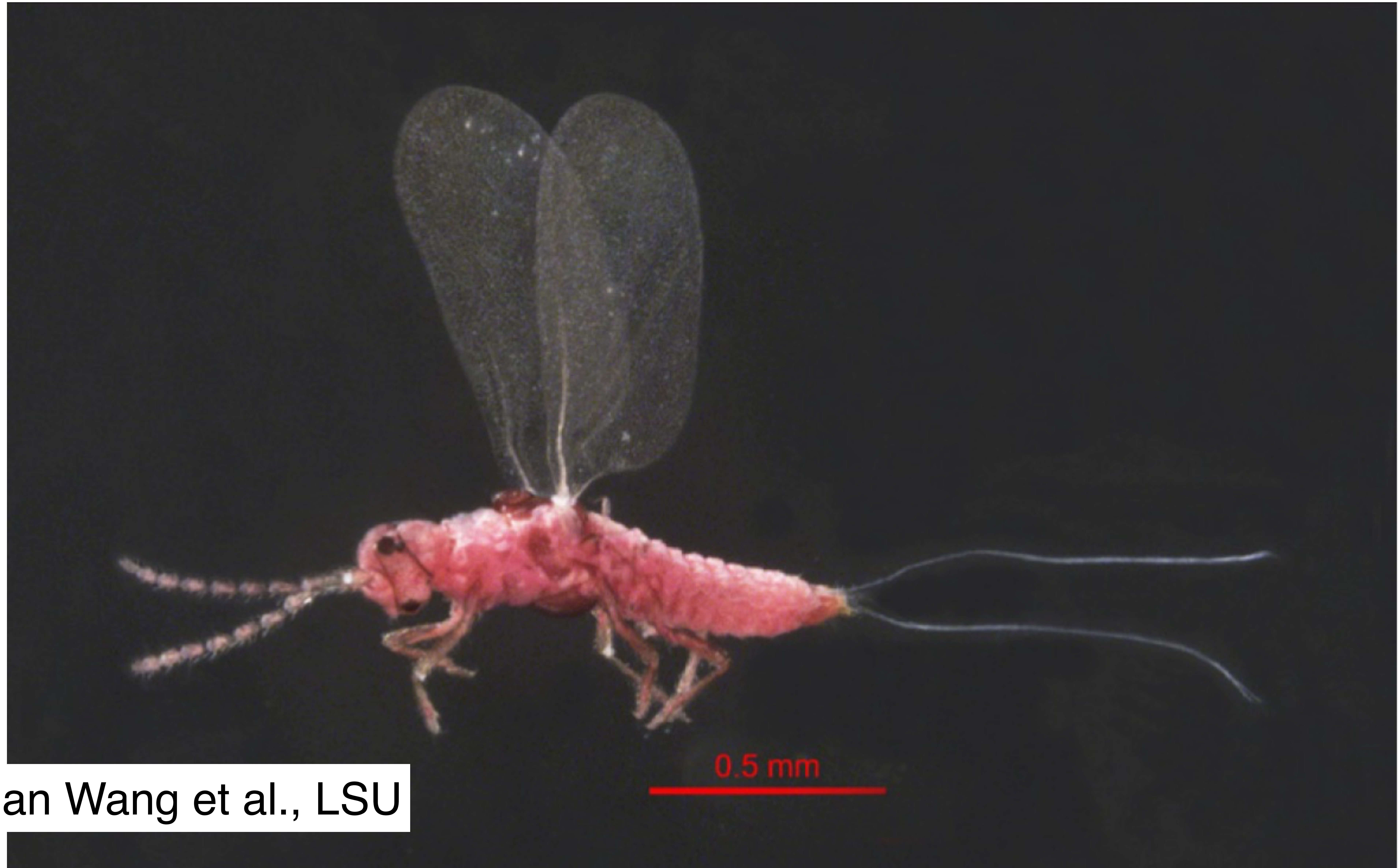
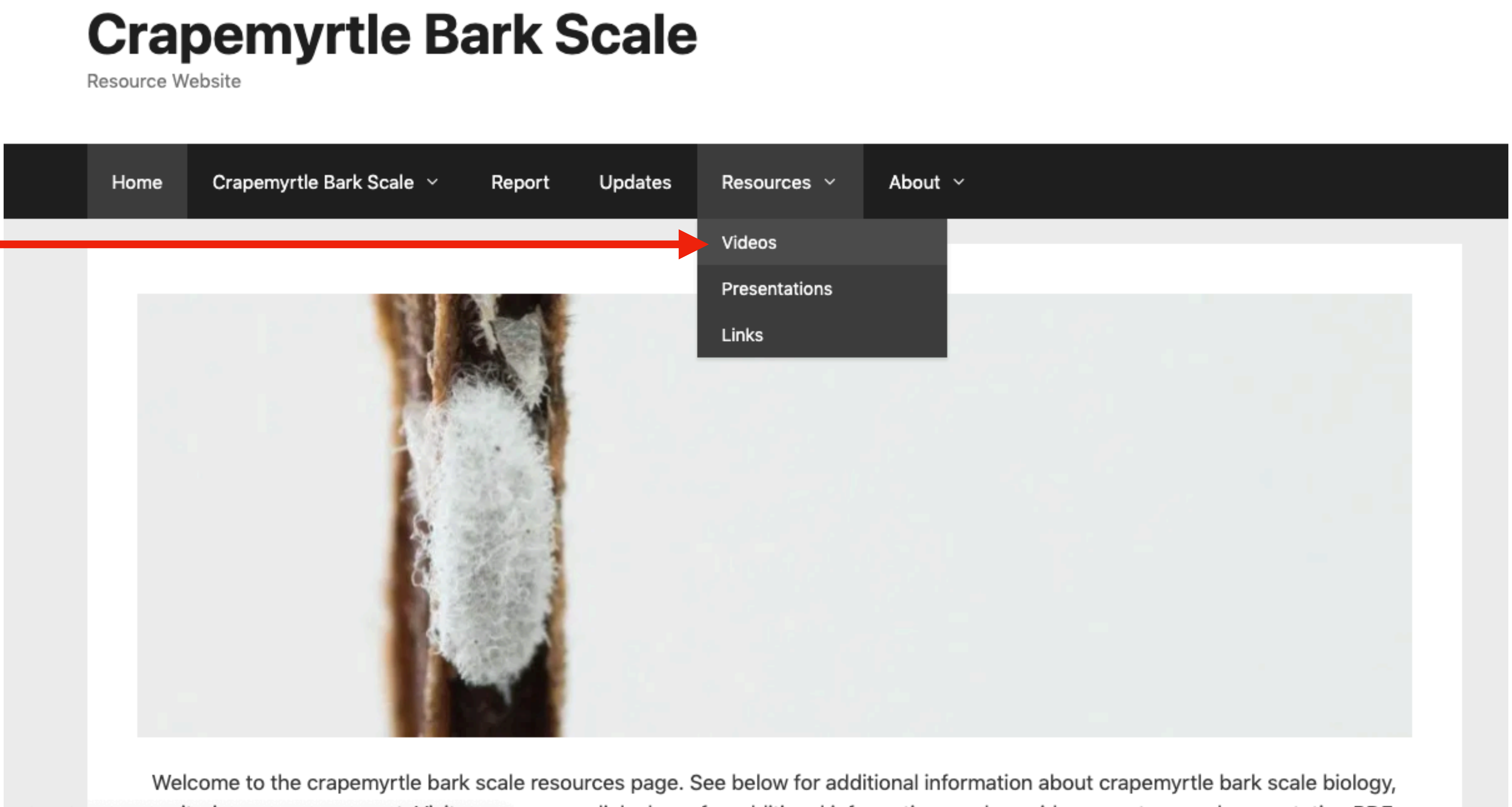


Photo courtesy of Zinan Wang et al., LSU

STOPCMBS.COM



STOPCMBS.COM

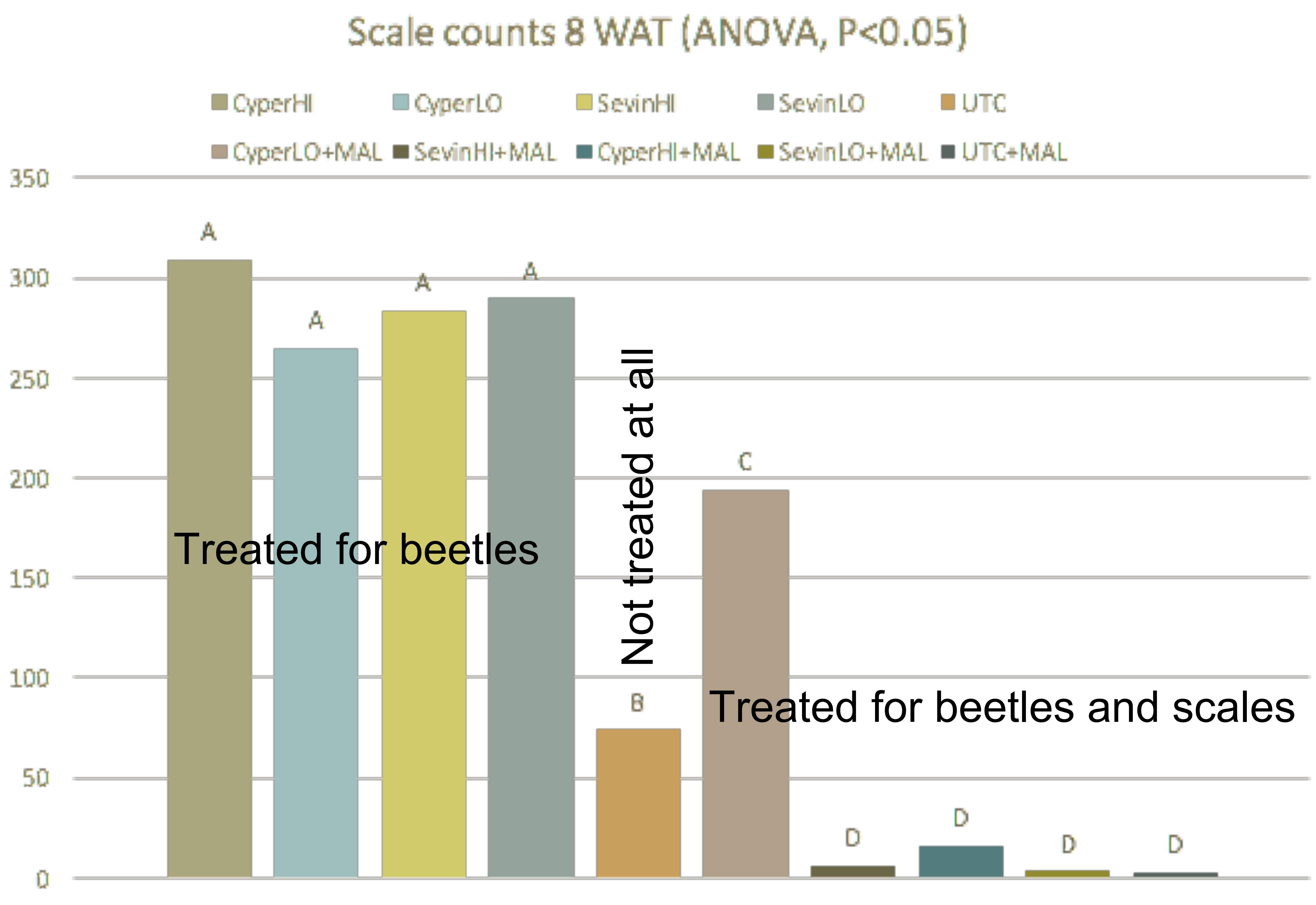
Home | Crapemyrtle Bark Scale | Report | Updates | Resources | About

Videos

2018. How to treat for crapemyrtle bark scale. Dr. Michael Merchant.

Length: 9 minutes and 24 seconds.

Crapemyrtle bark scale



Merchant 2016

Kyle Gilder, Texas A&M

Crapemyrtle bark scale?

Monitoring/Scouting

Invasives | Lantern fly

Lawrence Barringer, Pennsylvania Department of Agriculture, Bugwood.org

Monitoring/Scouting

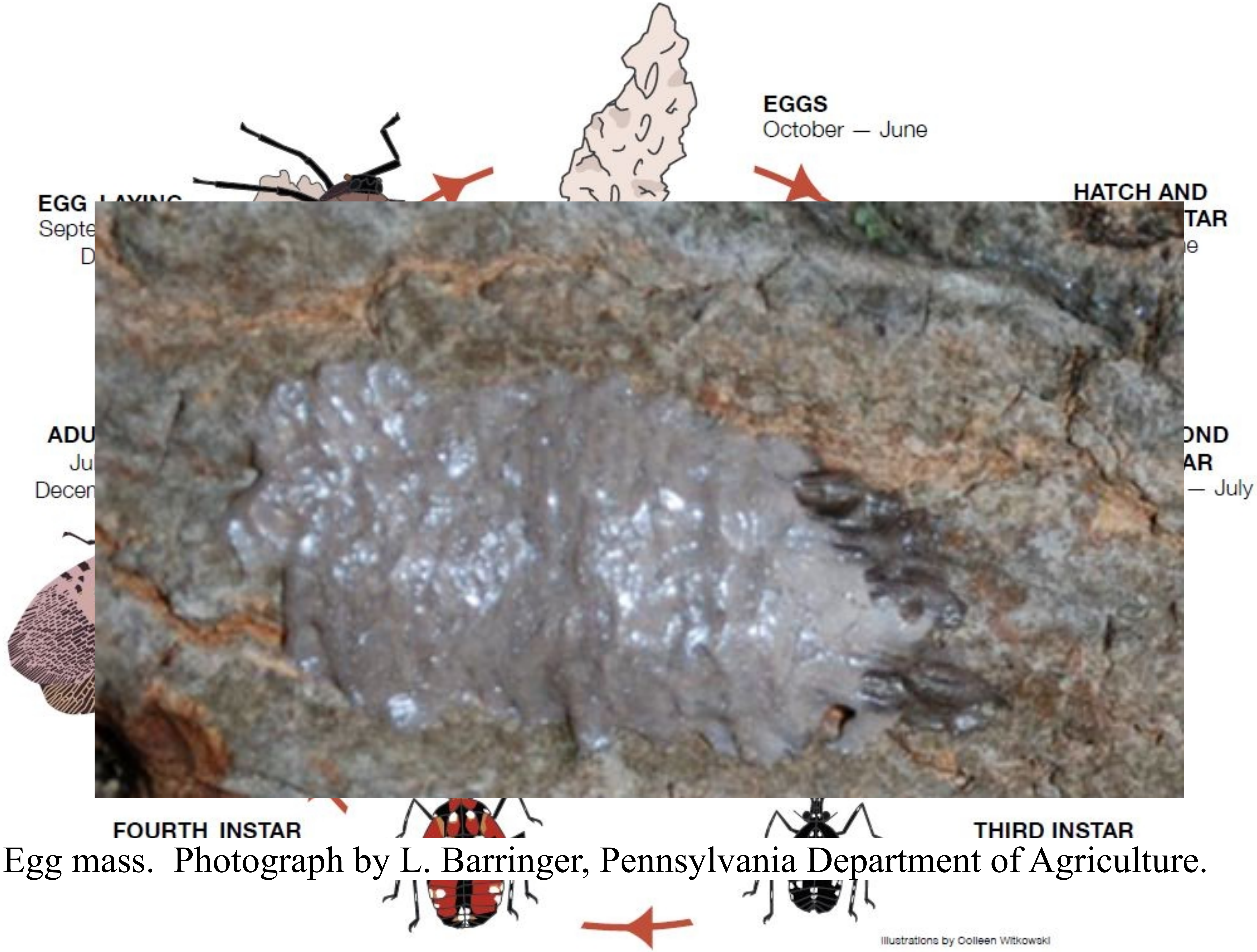
Invasives | Lantern fly

- *Lycorma delicatula*
- First detected in Pennsylvania in 2014.
  - (2018) also found in Delaware, New Jersey, New York, Pennsylvania and Virginia
  - Introduced from Asia
- Preferred Plant Host: Tree of Heaven (*Ailanthus altissima*)

Monitoring/Scouting

Invasives | Lantern fly

- Sucking pest
  - Produced honeydew and subsequent sooty mold
- Feeds on over 70 host plants, including grapes, hops, apples, cherry, stone fruits and walnuts



Egg mass. Photograph by L. Barringer, Pennsylvania Department of Agriculture.

Monitoring/Scouting

Invasives | Lantern fly

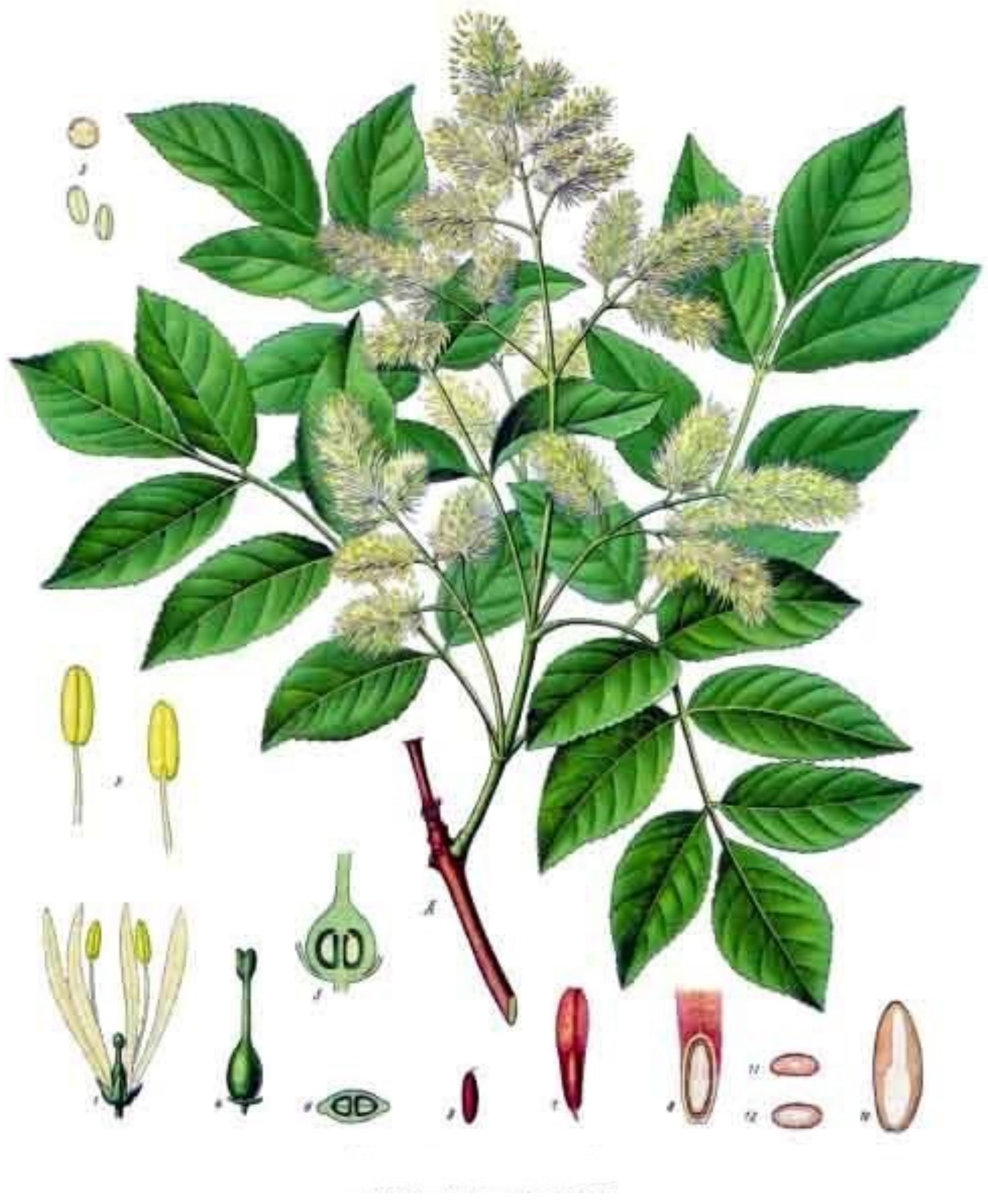
https://www.youtube.com/watch?time_continue=26&v=vE1QJ4ADV7c

Photograph by Lyle J. Buss, University of Florida.

Emerald Ash Borer

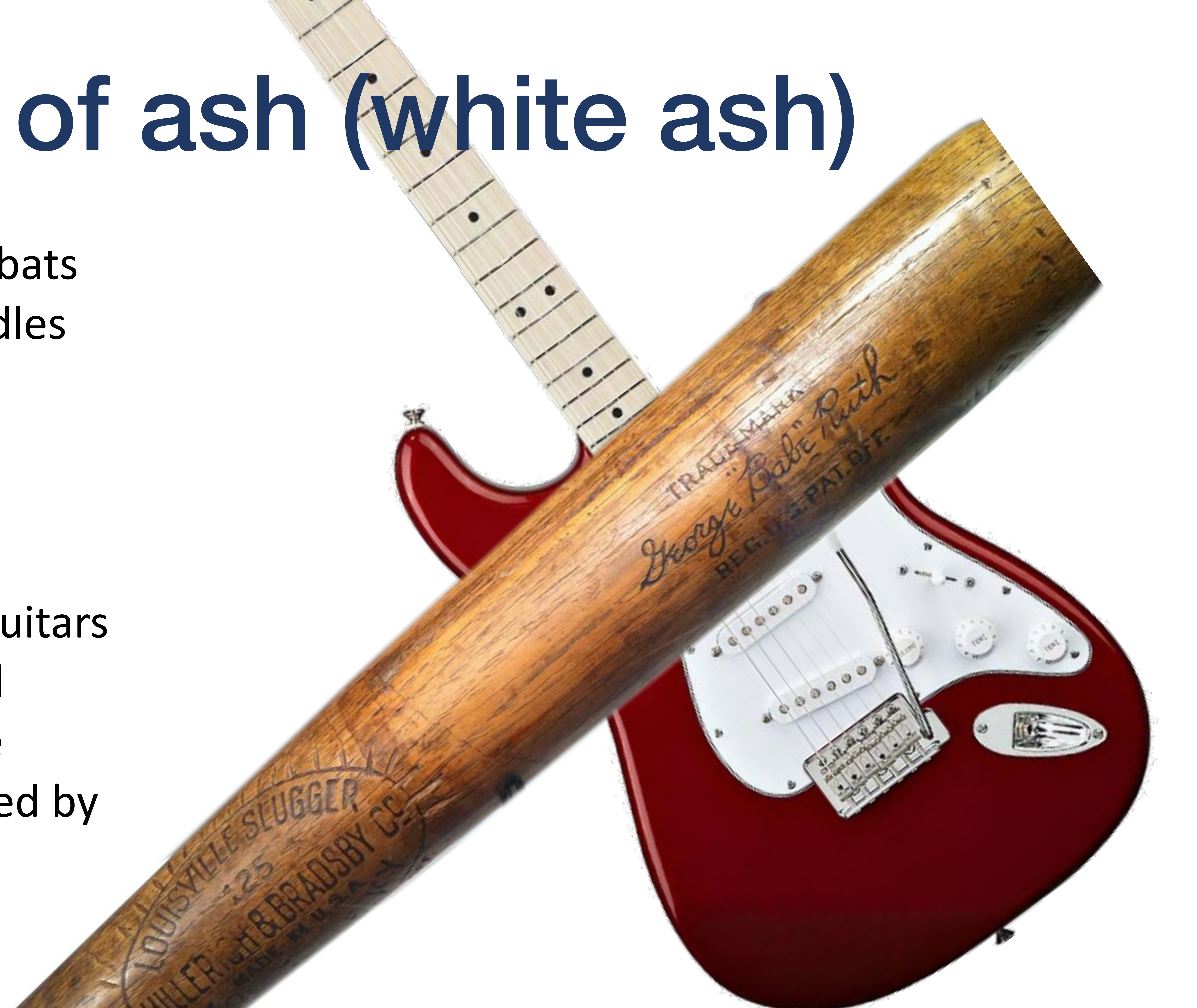
Ash in the United States

- *Fraxinus*: genus of flowering trees in family, Oleaceae
- 21 species of trees in North America north of Mexico
- Opposite leaves, usually pinnately compound



Uses of ash (white ash)

- Baseball bats
- Tool handles
- Oars
- Pallets
- RR ties
- Bows
- Electric guitars
- Firewood
- Furniture
- Seeds used by birds



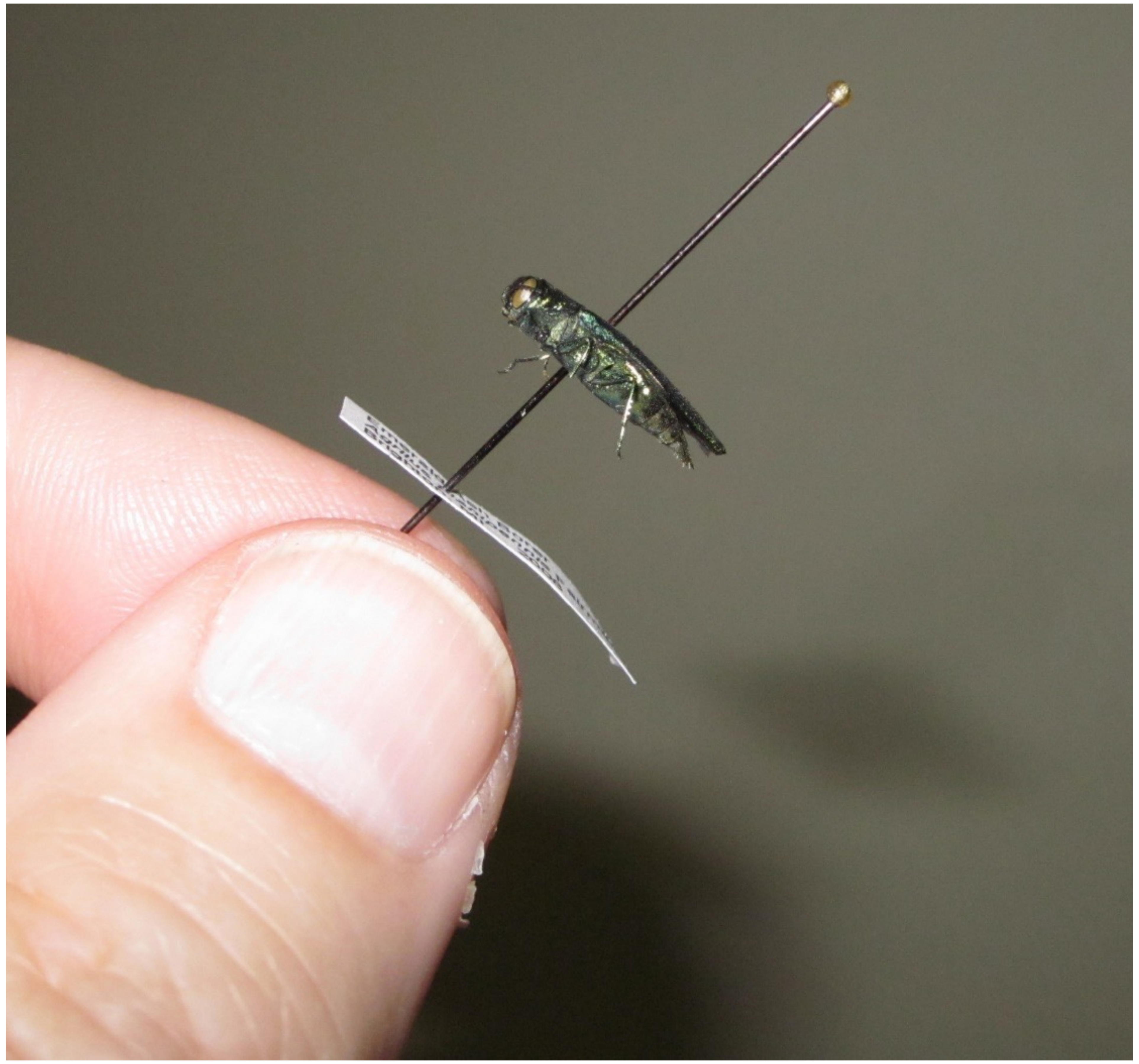
Emerald ash borer

- *Agrilus planipennis* (Coleoptera: Buprestidae)

- Native of Asia, first detected in Detroit MI in 2002 (prob. had been in MI since early 1990s)

- By 200 … illion dead or dying ash tree … ea of SE Michigan

History of EAB in U.S.



- Initially very little known about this insect
- Range from China, Korea, E. Russia
- Two pages in a Chinese textbook and a few taxonomic descriptions in journals

History of ash borer in U.S.

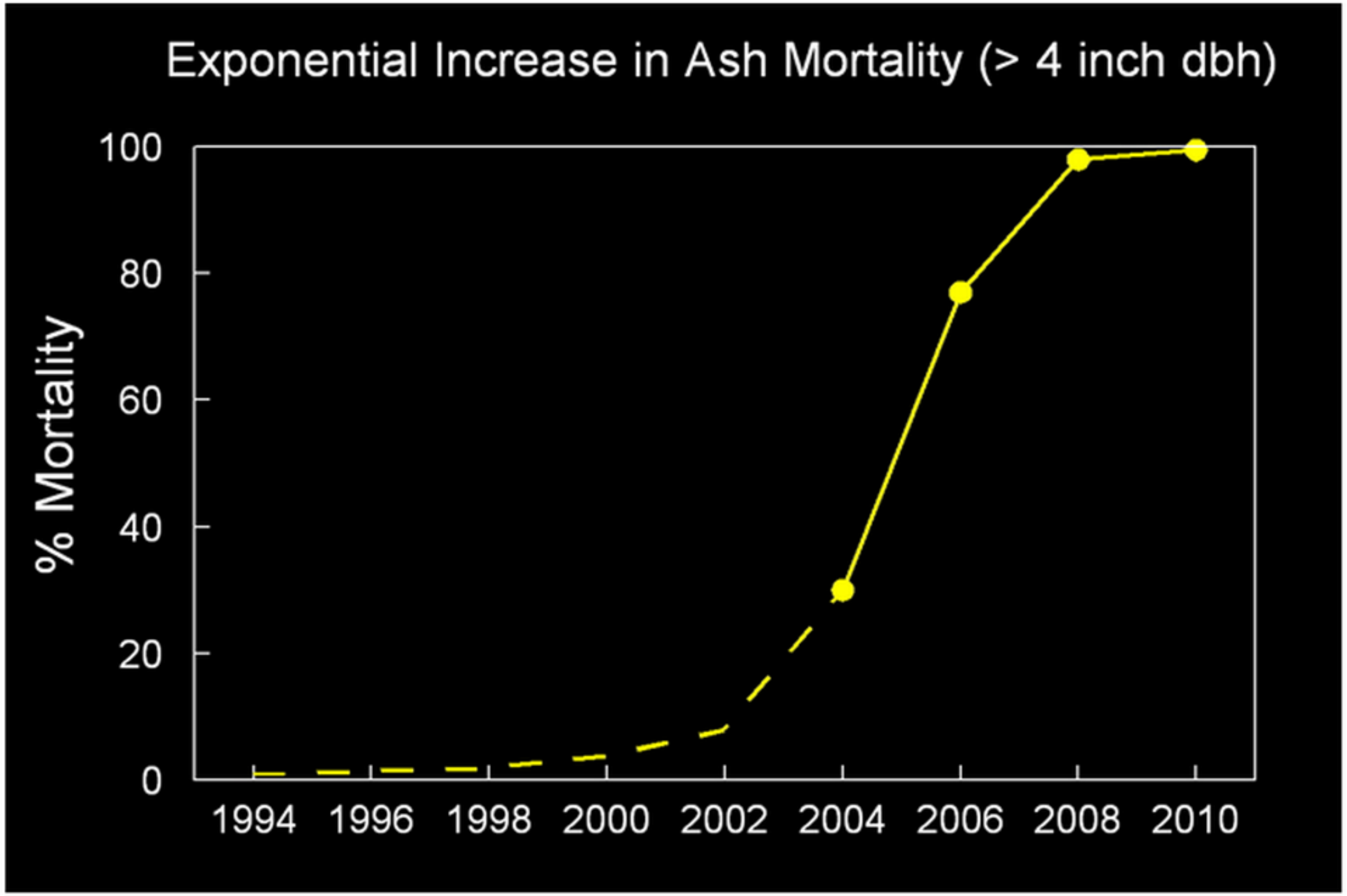
- Attacks all species of ash
- In U.S. attacks not only weakened trees, but heathy trees
- Attacks trees in forests and urban sites
- In MI, more than 99% of forest ash with stems >2.5 cm killed

Impact

- Larvae feed under bark, disrupt transport of water, nutrients
- Healthy trees killed within 1-3 years of first symptoms
- All sized trees attacked

Courtesy Dan Hermes, Ohio State University
Efficacy of insecticide treatments for EAB: they do work! July 2012

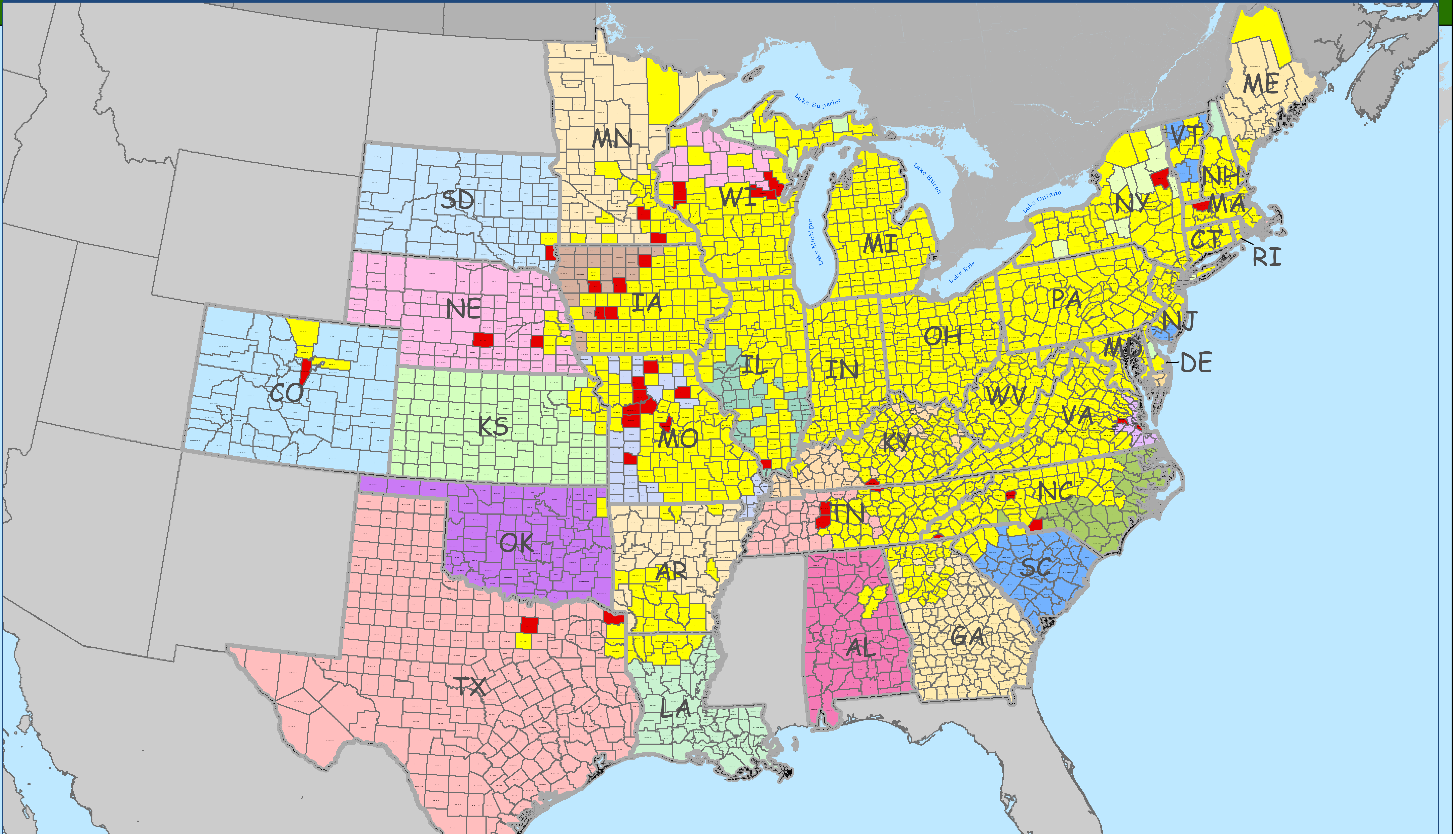
EAB-Induced Ash Mortality in the Upper Huron River Watershed, SE Michigan

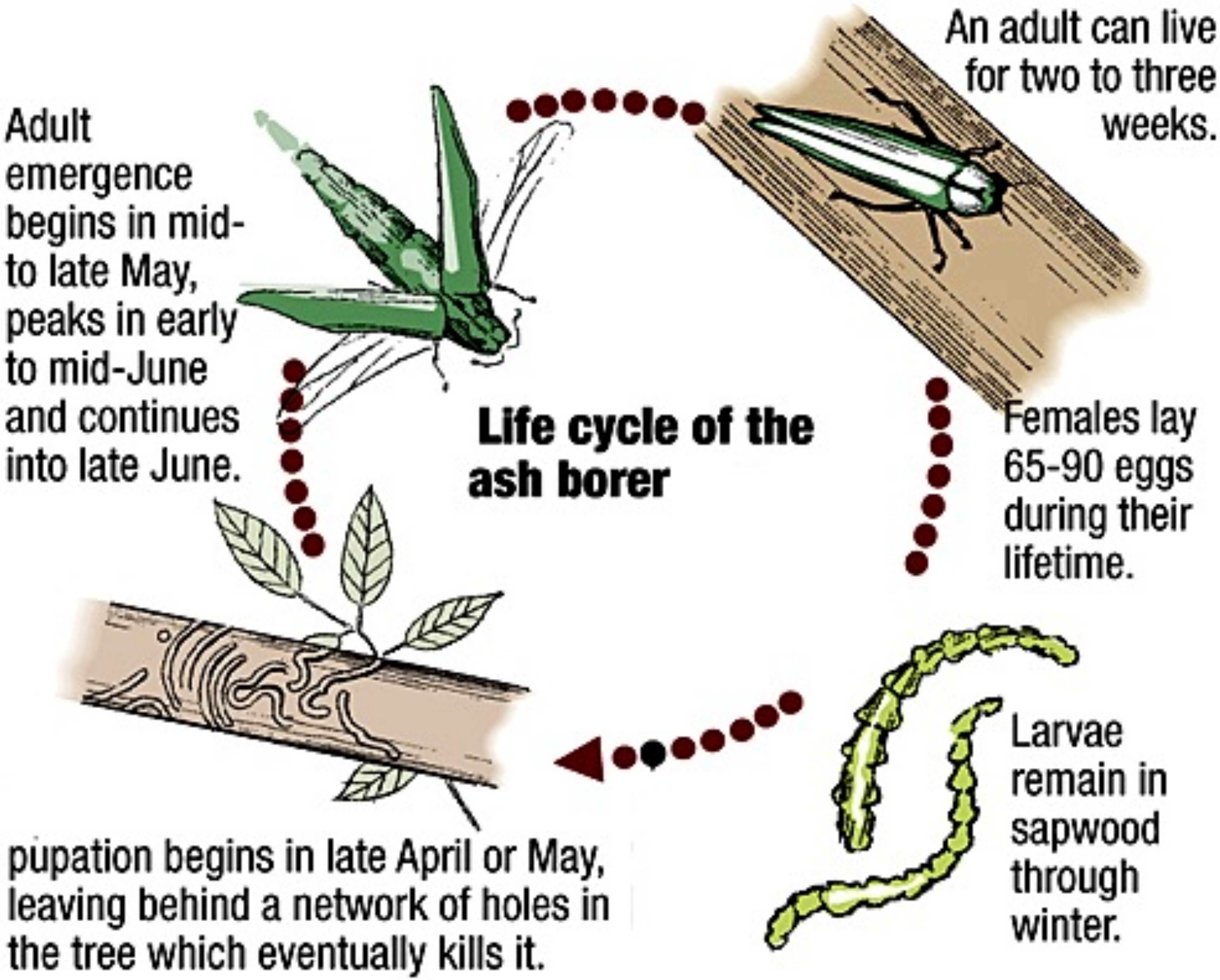


USDA United States Department of Agriculture

EAB COUNTY DETECTIONS -- SEPTEMBER 1, 2020

Cooperative Emerald Ash Borer Project



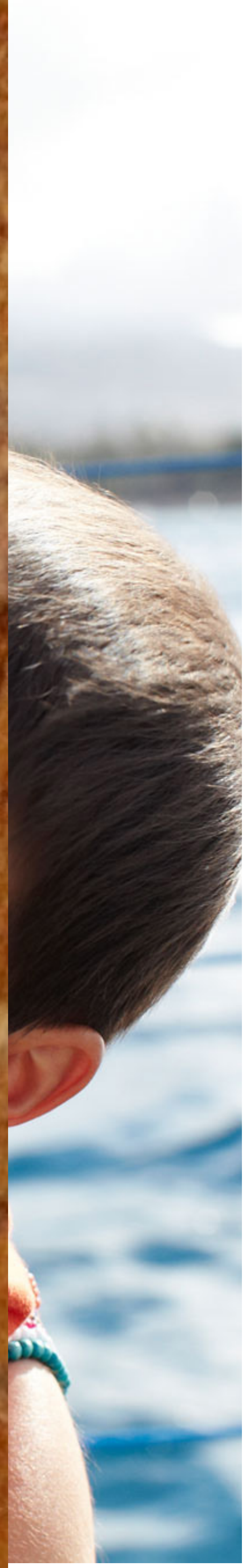

An adult can live for two to three weeks.
Adult emergence begins in mid- to late May, peaks in early to mid-June and continues into late June.
Life cycle of the ash borer
Females lay 65-90 eggs during their lifetime.
Larvae remain in sapwood through winter.
pupation begins in late April or May, leaving behind a network of holes in the tree which eventually kills it.

Recognizing damage

Emerald Ash Borer Larva

Courtesy Phil Nixon, University of Illinois

EAB larvae



Emergence Hole

Courtesy Phil Nixon, University of Illinois

Serpentine tunnels

Cornelia Schaible E+ Getty Images

EAB-encouraged Woodpecker Damage
“flecking”

EAB thinning canopy & epicormic branching

Courtesy Phil Nixon, University of Illinois

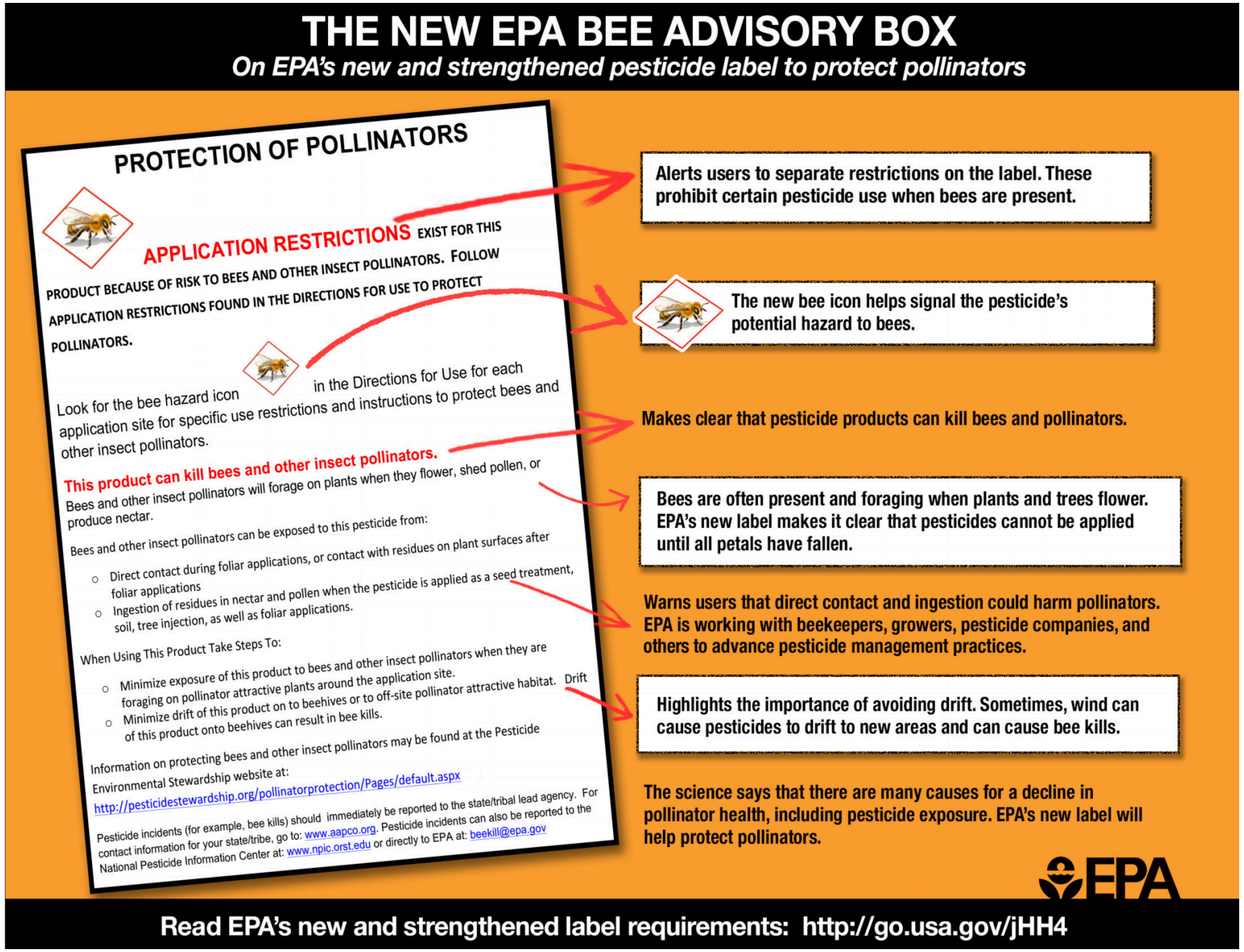
Courtesy Phil Nixon, University of Illinois

Pesticides

What are pesticides?

Pesticide Use

- Low residual
- High specificity
- “Natural” not always better
- Bee Advisory Box
- Good IPM Practices



Pesticide Use

150 lbs person = 68 kg

13.4 oz → Glyphosate

7.2 oz → Sodium chloride

~0.0033 oz / cup of coffee
0.46 oz = ~140 cups of coffee

0.46 oz → Caffeine

0.24 oz → DDT

1 apple seed ~ 0.24 mg of cyanide
0.01 oz = 1,181.2 apple seeds

0.01 oz → Hydrogen cyanide

Acute toxicity

Life-threatening one-time doses

SUBSTANCE	FOUND IN	Lethal dose (LD50 mg/kg)	CATEGORY
Water	... Water	90000	Practically non-toxic
Sucrose	Table sugar	30000	Practically non-toxic
Monosodium glutamate	Flavor enhancer, soy, cheese	16000	Practically non-toxic
Ethanol	Alcoholic beverages	7000	Practically non-toxic
Glyphosate	Herbicide (RoundUp)	5600	Practically non-toxic
Aluminum hydroxide	Antacid, vaccine adjuvant	>5000	Practically non-toxic
Fructose	Fruits, component of sucrose	4000	Slightly toxic
Spinosad	Organic insecticide	3700	Slightly toxic
Sodium chloride	Table salt	3000	Slightly toxic
Eugenol	Clove oil, organic pesticide	2700	Slightly toxic
Paracetamol (acetaminophen)	Tylenol, Panadol	2400	Slightly toxic
Vanillin	Vanilla bean, vanilla sugar	1600	Slightly toxic
Hydrogen peroxide 70%	Bleach, disinfectant	1000	Slightly toxic
Theobromine	Chocolate, tea, guarana	950	Slightly toxic
Copper sulfate	Organic fungicide	300	Moderately toxic
Chlorpyrifos	Organophosphate insecticide	230	Moderately toxic
Caffeine	Natural pesticide, coffee plant	190	Moderately toxic
Lead	Batteries, cables, paints	155*	Moderately toxic
DDT	Restricted insecticide	100	Moderately toxic
Rotenone	Restricted organic pesticide	60	Moderately toxic
Vitamin D3	Supplements, fish, mushrooms	37	Highly toxic
Nicotine	Natural pesticide, tobacco	10	Highly toxic
Mycotoxin T2	Plant pathogen, moldy grain	5	Highly toxic
Aflatoxin	Soil fungus, moldy foods	5	Highly toxic
Hydrogen cyanide	Fruit pits, bitter cassava	4	Highly toxic
Botulinum toxin	Botox, Clostridium botulinium	0.001	Highly toxic

LD50: Generally rat oral. Botulinum: mouse and human, nicotine: human, cyanide: mouse.
*Lead: no LD50, lowest human lethal dose included. Colours: EPA toxicity categories.

Thoughtscapism — Measures of Toxicity — thoughtscapism.com — Sources: EFSA, WHO, EPA, NIH, NHS — Mommy PhD

Pesticide Use

UC IPM STATEWIDE INTEGRATED PEST MANAGEMENT PROGRAM
UNIVERSITY OF CALIFORNIA AGRICULTURE & NATURAL RESOURCES

How to Manage Pests

Pesticide Active Ingredient	Potential Hazard[1] to					Notes
	Water quality[2] (aquatic wildlife)	Natural enemies (beneficials)	Honey bees[3]	People and Other Mammals		
				Acute[4]	Long Term[5]	
Azadirachtin	M	LM	M	VL	Not listed	
Dinotefuran	L	LH	VH	L	Not listed	
Horticultural oil	NKR	L	M	VL	Not listed	
Neem oil	NKR	L	M	VL	Not listed	
Pyrethrin	H	M	M	L	Not listed	
Soap	NKR	L	L	VL	Not listed	
Spinosad	L	LM	M	L	Not listed	

- **On US EPA list:** Not listed;
- **On CA Proposition 65 list:** Not listed

Water Quality Rating[2]

Insecticide resistance

Arthropod Pesticide Resistance Database

Welcome | Search | Login | Sign Up | Contact

Order: Select to Add **Family:** Select to Add **Genus:** Select All **Active Ingredient:** All **MOA Abbr:** All

Resistance Year: All **Publication Year:** All **Country:** All

Search | Reset

Parameters: **Selecting multiple parameters from same catagory is treated as OR**

Genus: [bemisia **X**]

Genus Species	Taxonomy (family - order)	Common Name(s)	# Cases	Group
bemisia argentifolii	aleyrodidae homoptera	silverleaf whitefly	22	AG
bemisia tabaci	aleyrodidae homoptera	sweetpotato whitefly	593	AG

Permission MUST be granted if you intend to base a significant portion of a scientific paper on data derived from this site.

Insecticide resistance

Arthropod Pesticide
Resistance Database

Welcome | Search | Login | Sign Up | Contact

Order: Select to Add **Family:** Select to Add **Genus:** Select All **Active Ingredient:** All **MOA Abbr:** All

Resistance Year: All **Publication Year:** All **Country:** All **Type of Resistance:** All

Search | Reset

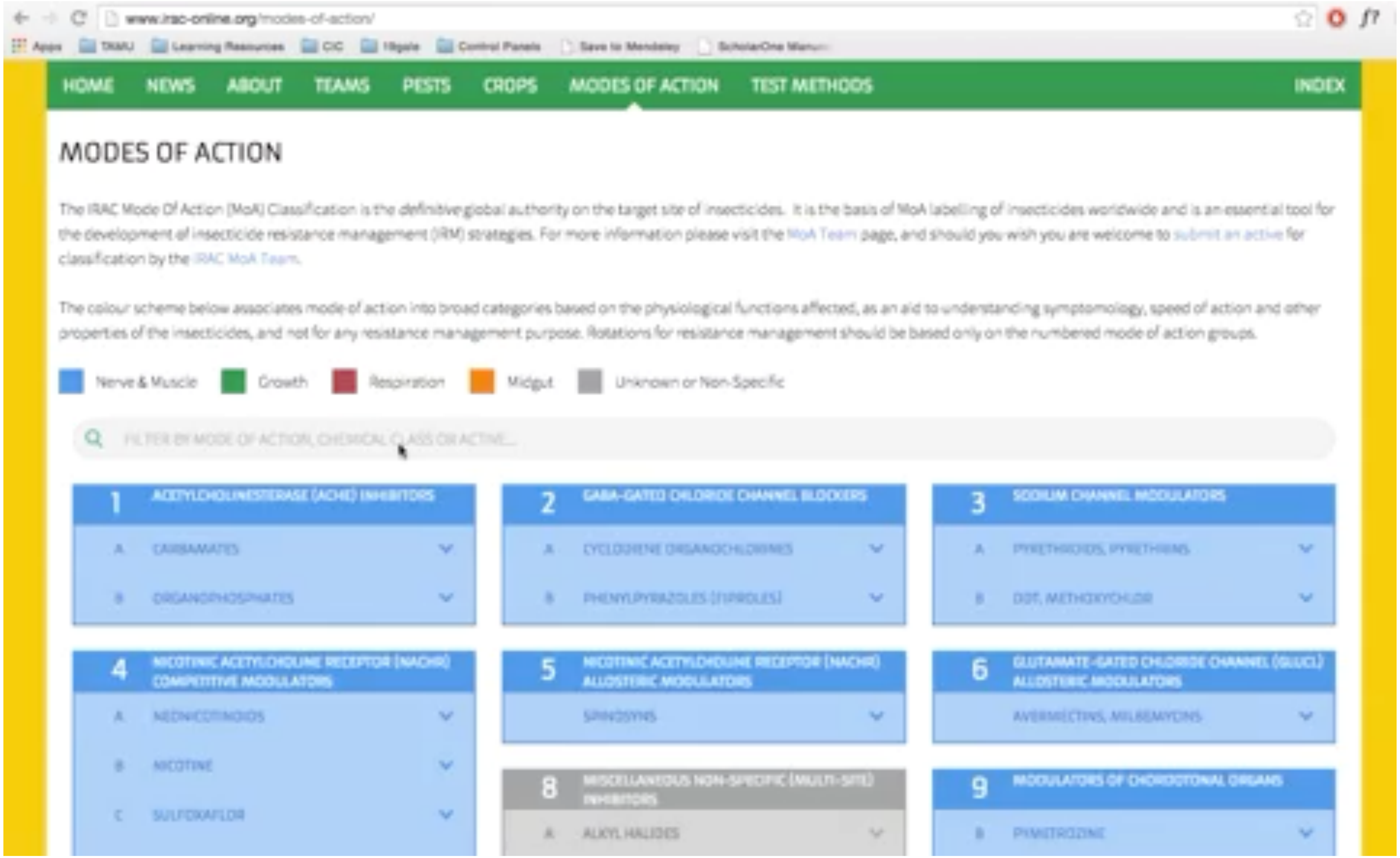
Parameters: **Selecting multiple parameters from same catagory is treated as OR**

Order: [thysanoptera **X**]

Genus Species	Taxonomy (family - order)	Common Name(s)	# Cases	Group
chaetanaphothrips orchidii	thripidae thysanoptera	orchid thrips	2	AG
diarthrothrips coffeae	thripidae thysanoptera	coffee thrips	1	AG
frankliniella occidentalis	thripidae thysanoptera	western flower thrips	175	AG
frankliniella tritici	thripidae thysanoptera	flower thrips	2	AG
scirtothrips citri	thripidae thysanoptera	citrus thrips	22	AG
scirtothrips dorsalis	thripidae thysanoptera	Cilli thrips / Yellow tea thrips	2	AG
taeniothrips simplex	thripidae thysanoptera		1	AG
Thrips hawaiiensis	thripidae thysanoptera		1	AG
thrips palmi	thripidae thysanoptera	melon thrips	5	AG
thrips tabaci	thripidae thysanoptera	onion thrips	114	AG

Citation of the Arthropod Pesticide Resistance Database:
Mota-Sanchez, D. and J.C. Wise. 2020. The Arthropod Pesticide Resistance Database.
Michigan State University. On-line at: http://www.pesticideresistance.org

Insecticide Resistance Action Committee | irac-online.org



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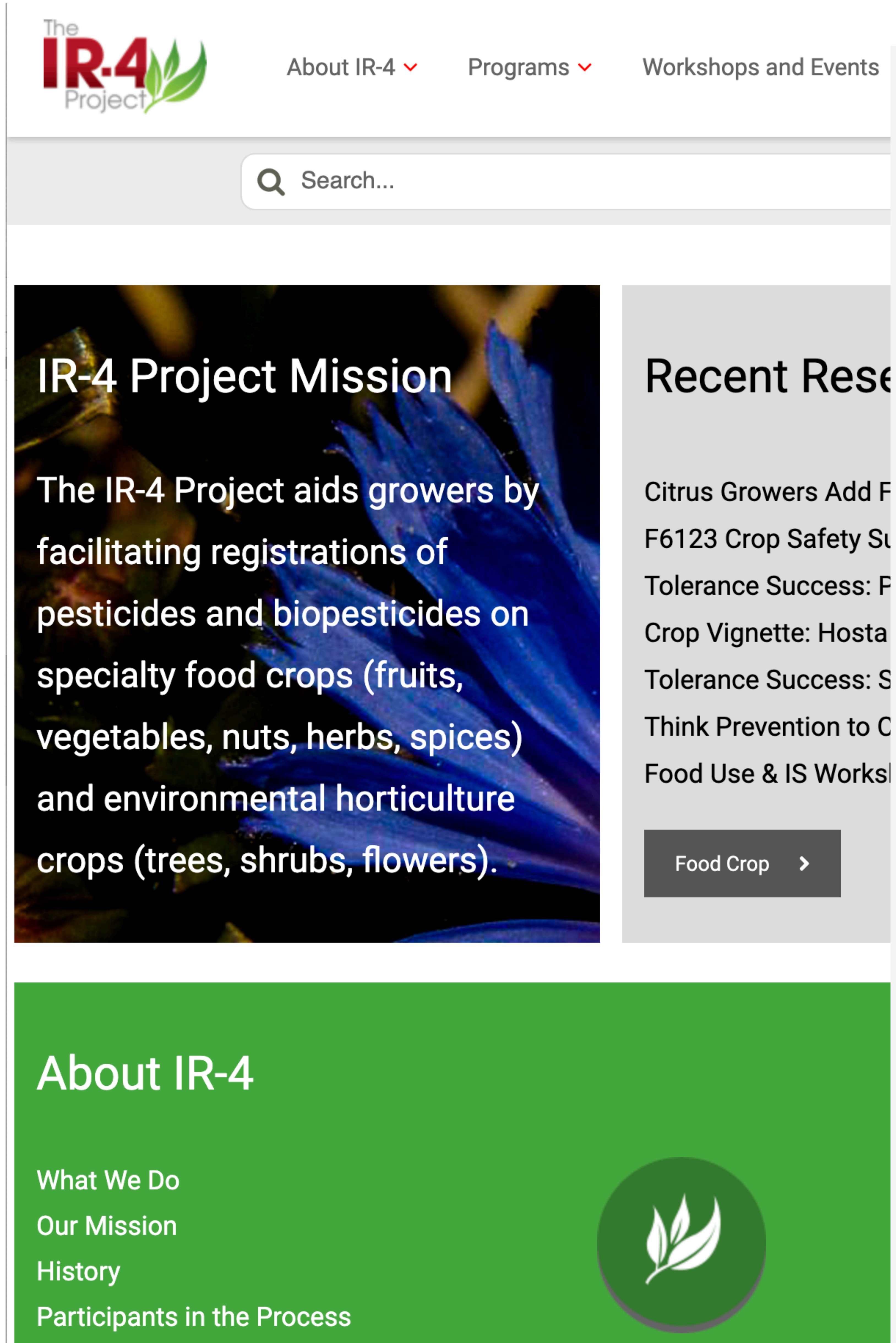

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The IR-4 Project aids growers by facilitating registrations of pesticides and biopesticides on specialty food crops (fruits, vegetables, nuts, herbs, spices) and environmental horticulture crops (trees, shrubs, flowers).
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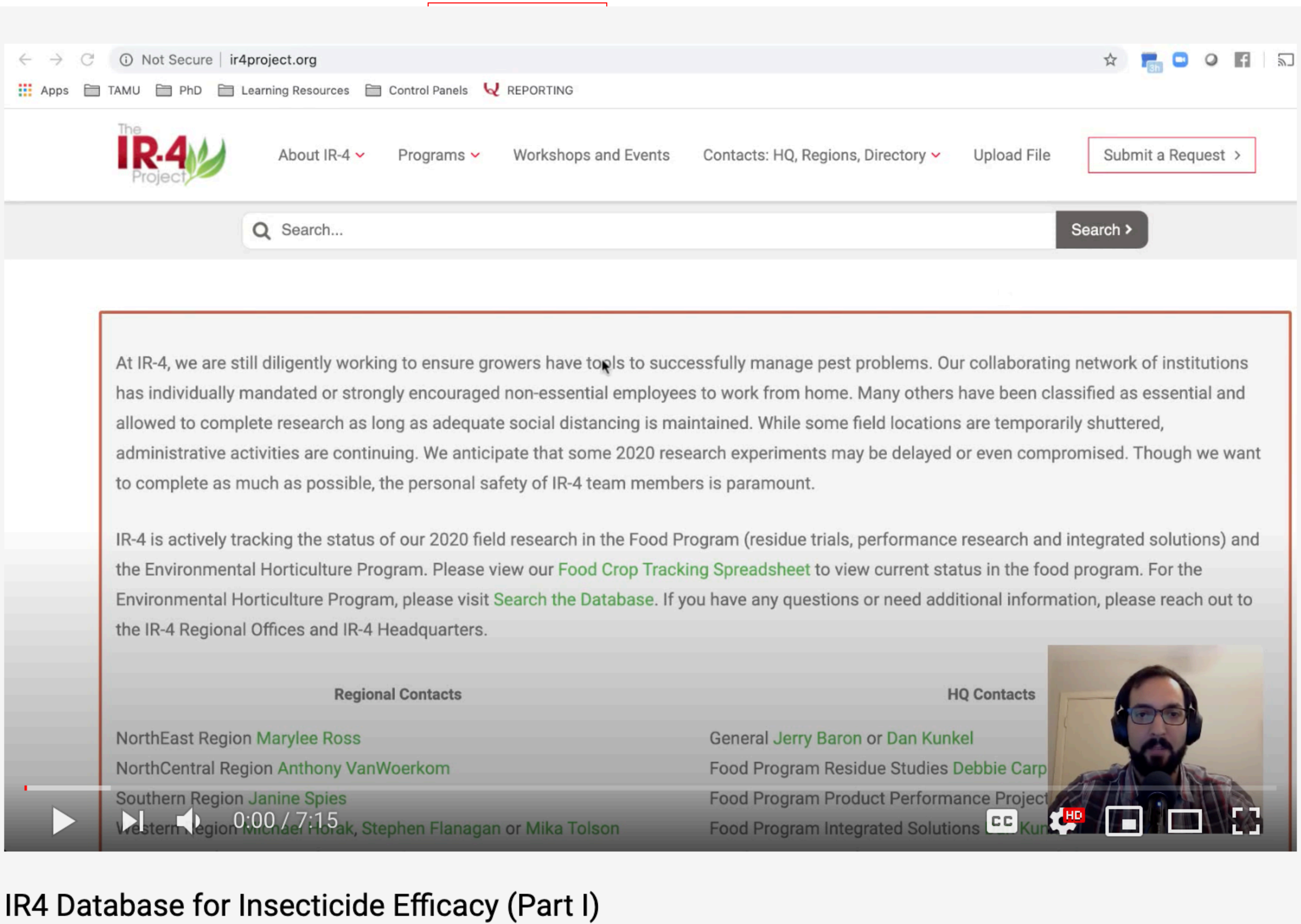

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At IR-4, we are still diligently working to ensure growers have tools to successfully manage pest problems. Our collaborating network of institutions has individually mandated or strongly encouraged non-essential employees to work from home. Many others have been classified as essential and allowed to complete research as long as adequate social distancing is maintained. While some field locations are temporarily shuttered, administrative activities are continuing. We anticipate that some 2020 research experiments may be delayed or even compromised. Though we want to complete as much as possible, the personal safety of IR-4 team members is paramount.
IR-4 is actively tracking the status of our 2020 field research in the Food Program (residue trials, performance research and integrated solutions) and the Environmental Horticulture Program. Please view our Food Crop Tracking Spreadsheet to view current status in the food program. For the Environmental Horticulture Program, please visit Search the Database. If you have any questions or need additional information, please reach out to the IR-4 Regional Offices and IR-4 Headquarters.
Regional Contacts
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General Jerry Baron or Dan Kunkel
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Food Program Product Performance Project
Food Program Integrated Solutions
Stephen Flanagan or Mika Tolson
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IR4 Database for Insecticide Efficacy (Part I)

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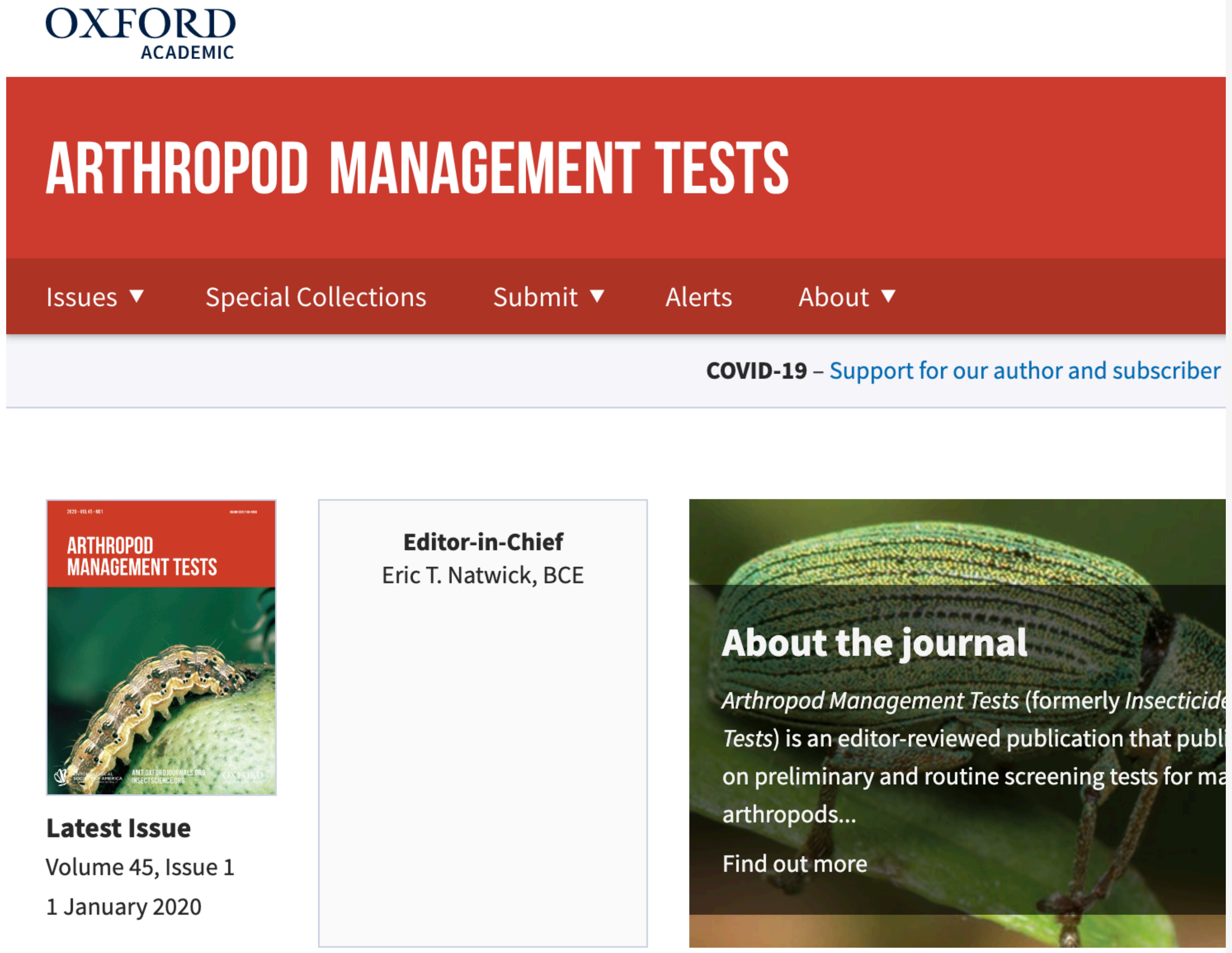

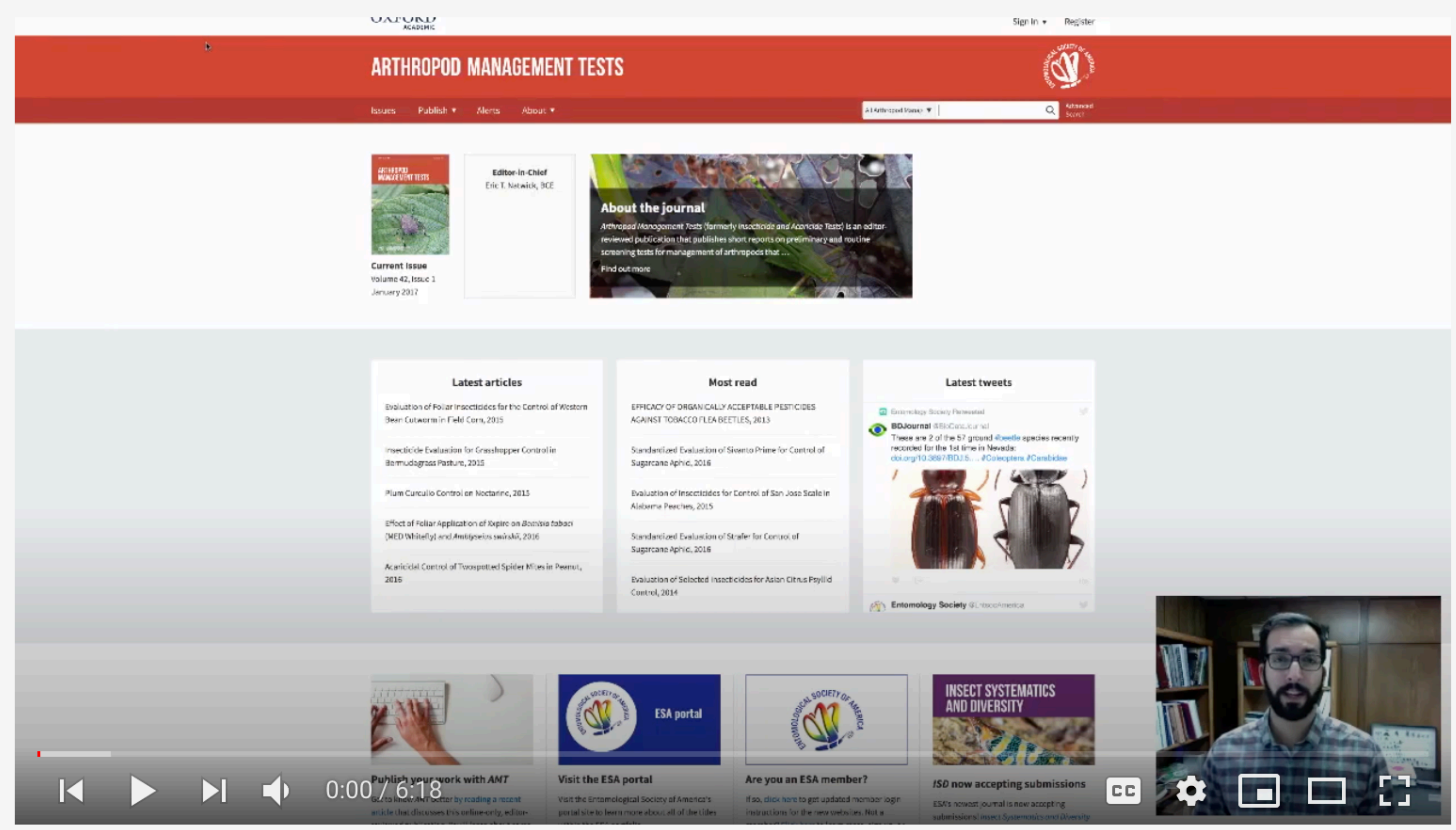

Arthropod Management Tests Tutorial

Resources

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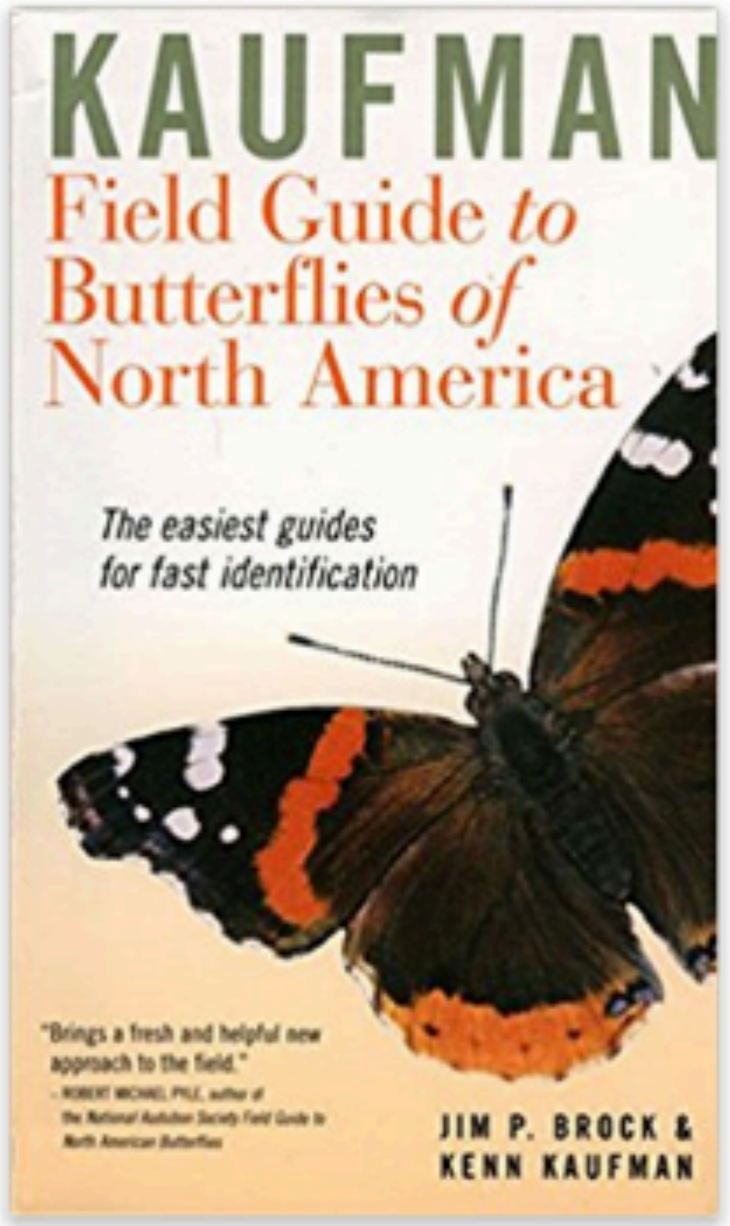

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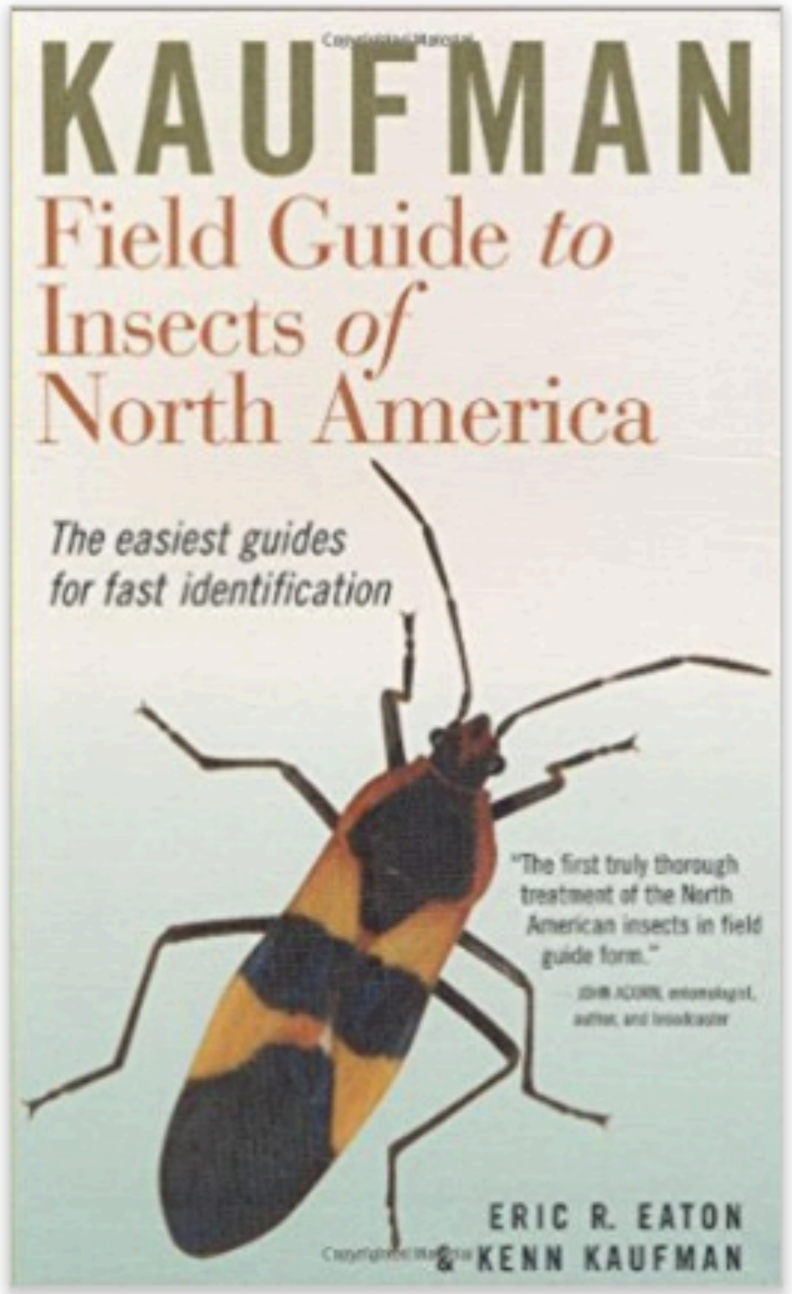

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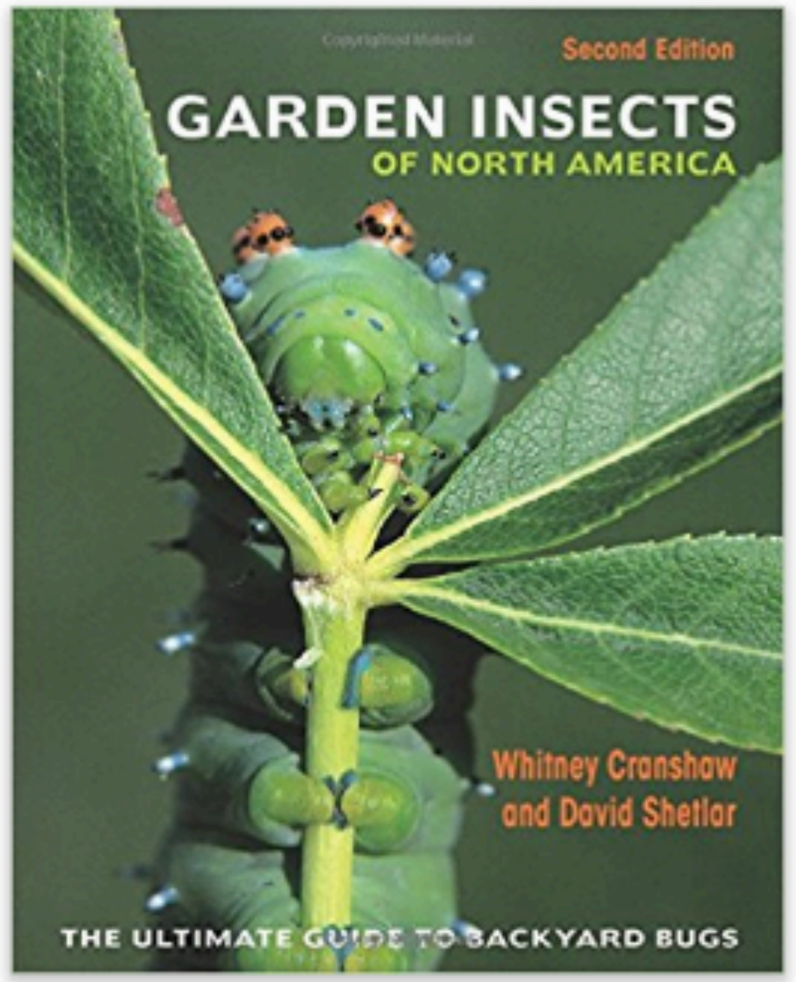

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1/3

1 out of 3

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The field of entomology is incredibly vast, with professionals focusing on viruses vectored by the deadliest animal (mosquitoes), academics studying the mechanisms of freeze tolerance, government researchers tackling insects that could pose biosecurity threats, and forensic entomologists arriving at the crime scene. In this series, learn a bit more about who these entomologists are, what inspired them to get into the field, and discuss some of their most recent research.

Thank you!

Bugs in Our Gardens

Erfan Vafaie
Extension Program Specialist IPM-II

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