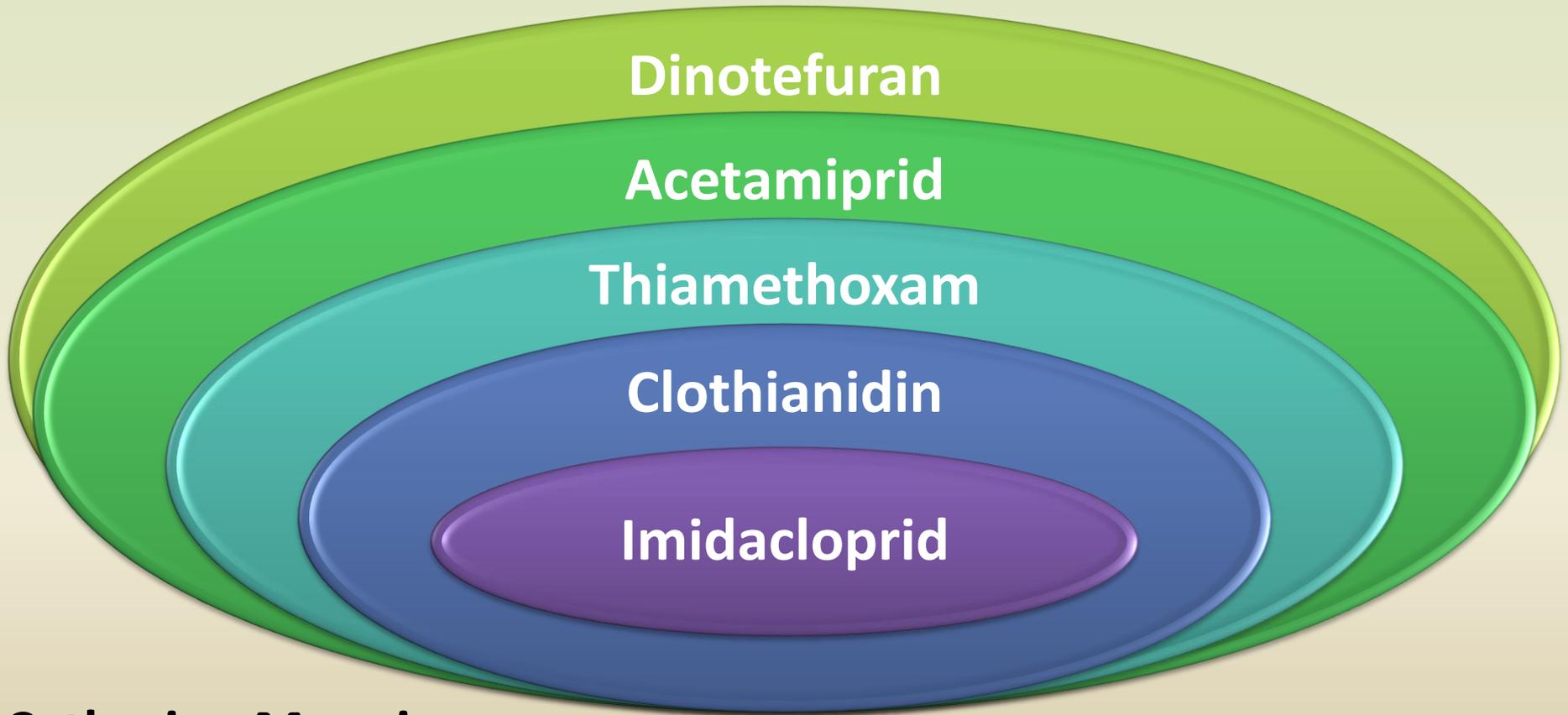


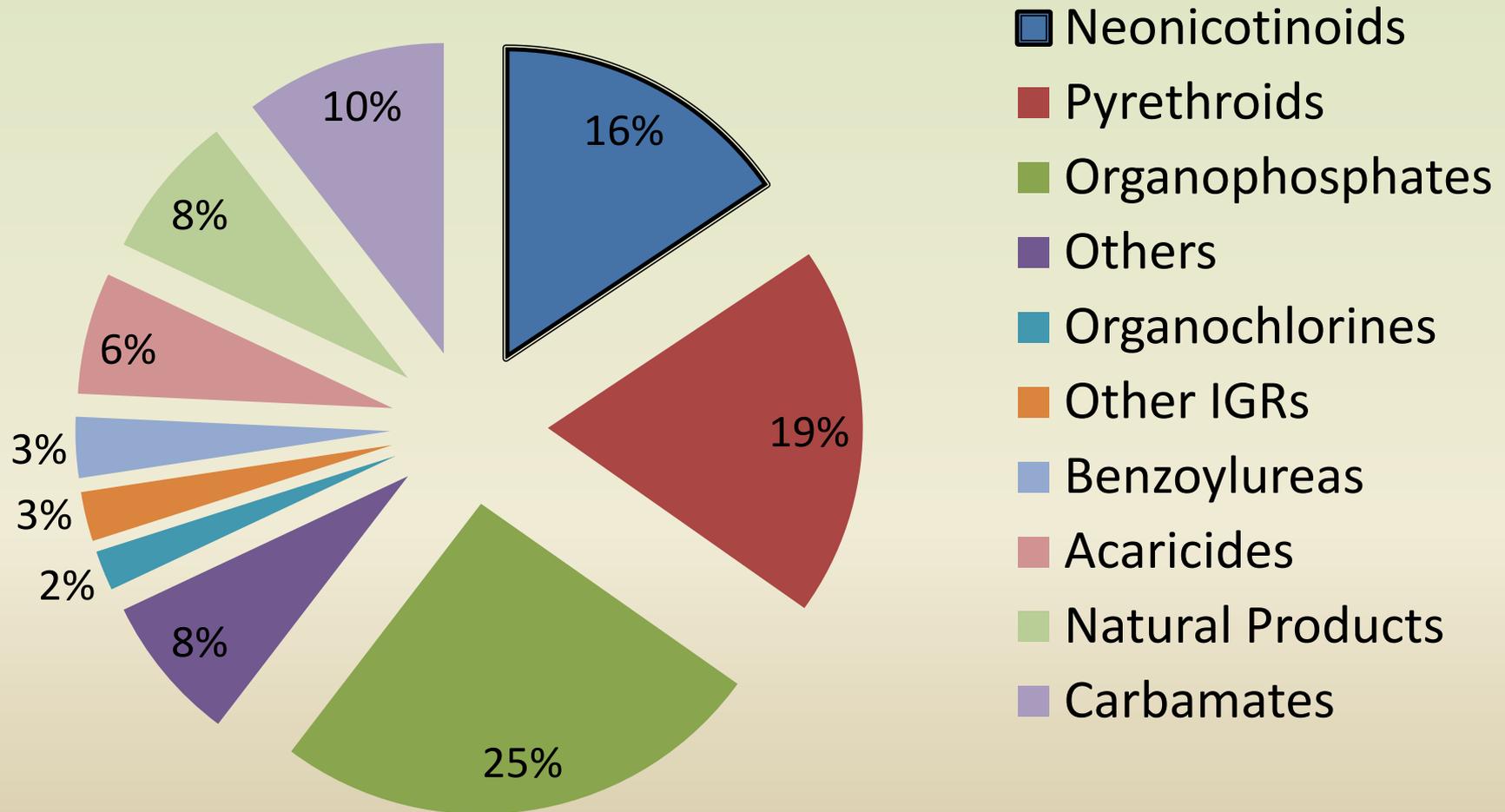
# Neonicotinoid Management Application, Resistance, and Bee Protection



**Catharine Mannion**  
**University of Florida, IFAS**  
**Tropical Research and Education Center**

# Global Insecticide Sales 2003

## Percent Sales



# Neonicotinoids

**Active  
Ingredient**

**Trade Names  
Professional Use**

Acetamiprid

TriStar (no soil application)

Clothianadin

Arena, (Aloft – no longer available in Florida)

Dinotefuran

Safari, Zylam

Imidacloprid

Merit, Marathon, Coretect, Discus, Allectus, several generic labels

Thiamethoxam

Flagship, Meridian

# Pest Groups Targeted

- **Hemiptera**
  - Adelgids
  - Aphids
  - Bugs
  - Leafhoppers
  - Mealybugs
  - Psyllids
  - Scales
  - Whiteflies
- **Coleoptera**
  - Beetles
  - Weevils
- **Others**
  - Ants
  - Fungus gnats
  - Craneflies
  - Leafminers
  - Thrips

# Neonicotinoid Insecticides

## A Few Simple Facts

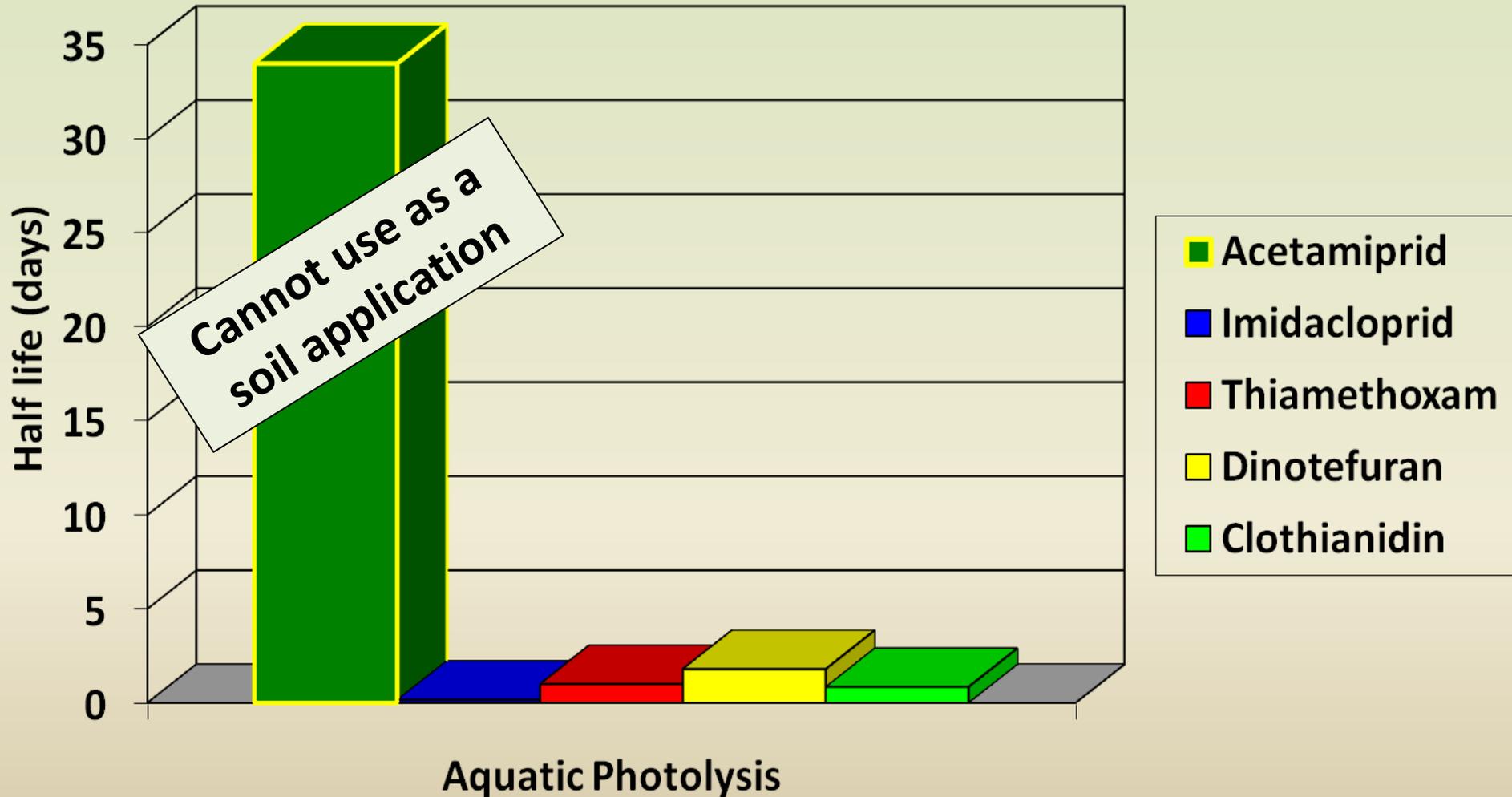
- One of the most widely used insecticides in the world
- First developed due to reduced toxicity compared to organophosphate (i.e. malathion, chlorpyrifos) and carbamate (i.e. carbaryl) insecticides
- Neurotoxins with high toxicity to most arthropods

# Neonicotinoid Insecticides

## A Few Simple Facts

- IRAC Mode of Action – 4A
- Toxic to insects in minute quantities (low rates)
- Water soluble and readily absorbed by plants – systemic
- Used on many agronomic and ornamental crops; widely applied as seed treatments

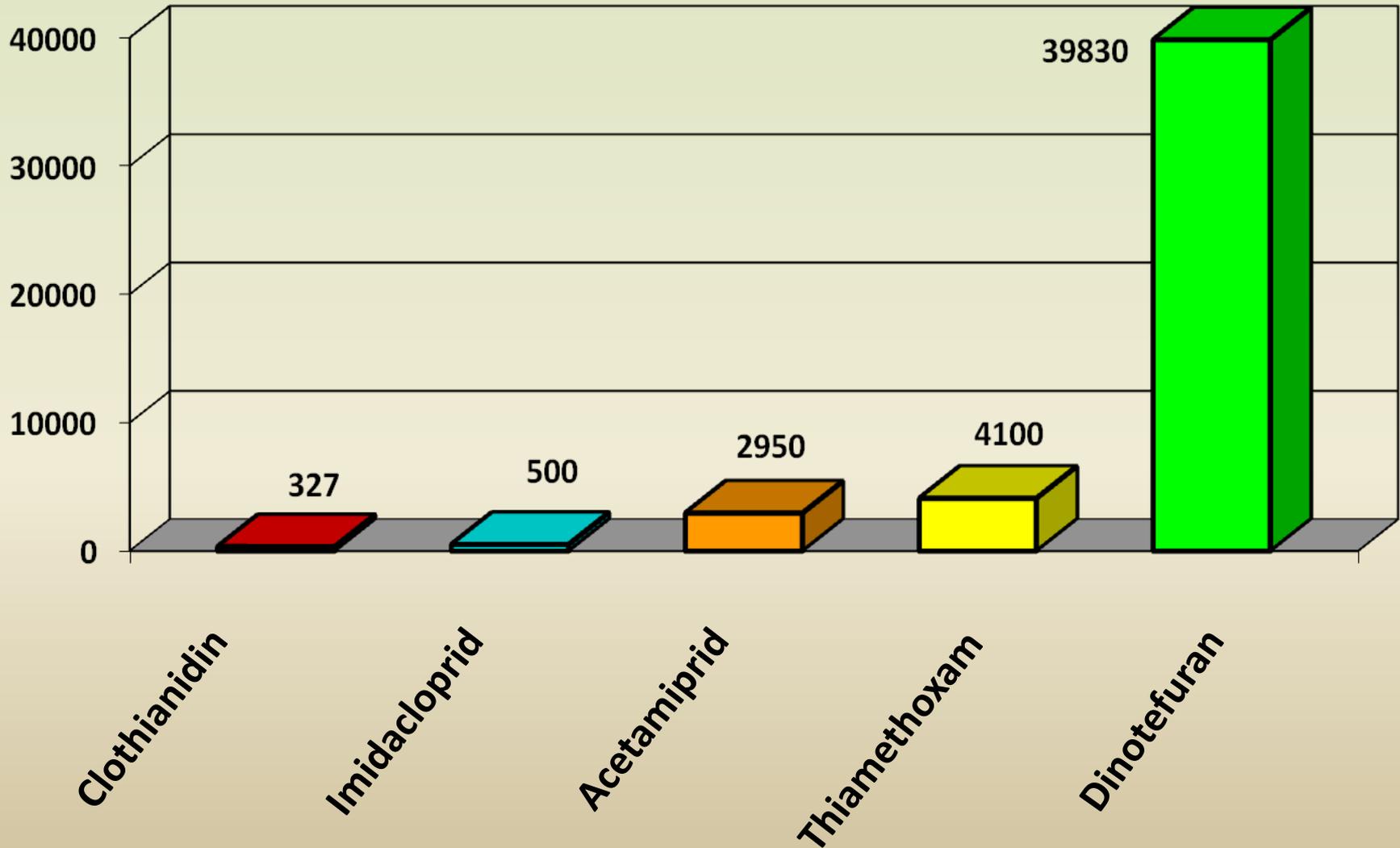
# UV Stability of Neonicotinoids



Slide Credit: Presentation by C. Sclar, Longwood Gardens

Data obtained from published EPA registration documents (R. Fletcher)

# Relative Water Solubility of Neonicotinoids



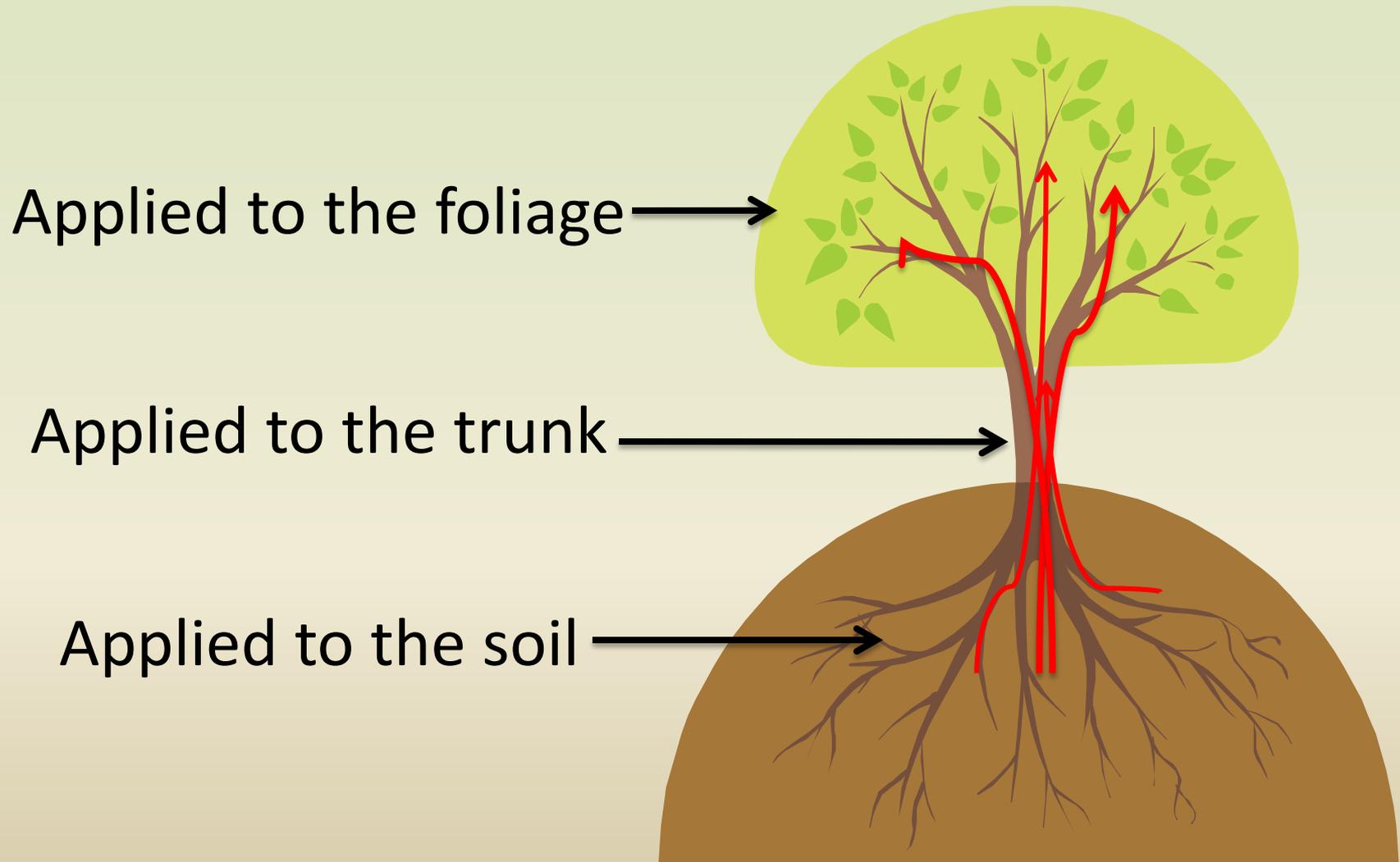
# Some Generalizations...

<b>Neonicotinoid A.I.</b>	<b>Relative Speed of Uptake</b>	<b>Relative Rate of Persistence</b>
Imidacloprid	Slow	Long
Clothianidin	Slow/Medium	Moderate/Long
Thiamethoxam	Medium/Fast	Short/Moderate
Acetamiprid	Fast	Short/Moderate
Dinotefuran	Fast	Short/Moderate

A.I.	Product	Application Site
Acetamiprid	Tristar	Ornamental and flowering plants grown outdoors and in greenhouses, shadehouses, and lathhouses; non-bearing fruit and nut trees
Clothianidin	Arena	Turfgrass and landscape ornamentals
Dinotefuran	Safari	Ornamental plants in greenhouse , lath and shadehouse, nursery and outdoor; vegetable transplants; interiorscape
	Zylam	Landscape ornamentals; turf
Thiamethoxam	Flagship	Ornamental plants in greenhouses, lath and shadehouses, containers, field nurseries (including non-bearing fruit and nut) and x-mas trees
	Arena	Turfgrass, sod farms, landscape ornamentals, interiorscapes, non-bearing fruit

<b>A.I.</b>	<b>Product</b>	<b>Application Site</b>
Imidacloprid	Merit	Turfgrass , sod farms, landscape ornamentals, fruit and nut trees and interiorscapes
	Allectus	Turfgrass and landscape ornamentals of residential lawns, commercial, industrial, institutional, and recreational areas
	Marathon	Ornamental and vegetable plants in greenhouses, nurseries and interiorscapes
	Discus	Ornamentals, non-bearing fruit and nut trees in field and container nurseries
	Coretect	Trees and shrubs in landscapes, interiorscapes and forested areas
	Generic labels	Variable

# Neonicotinoid Applications



Applied to the soil

Applied to the trunk

Applied to the foliage

Movement of the insecticide is upwards

## Drenching

- Water requirement
- Clean soil surface
- Best with moist soils
- No specialized equipment
- Relatively easy

## Granular or pellets

- Slow acting
- Pellets require burying
- Need water follow up
- Easy to apply
- No specialized equipment



## Injection

- Fast response
- Requires specialized equipment/formulations
- Must have knowledge of proper use
- Potential damage to trees
- Other a.i.'s available



## Basal bark spray

- Fast response
- Reduced water requirements
- Easy to apply
- No specialized equipment but does require some sort of sprayer

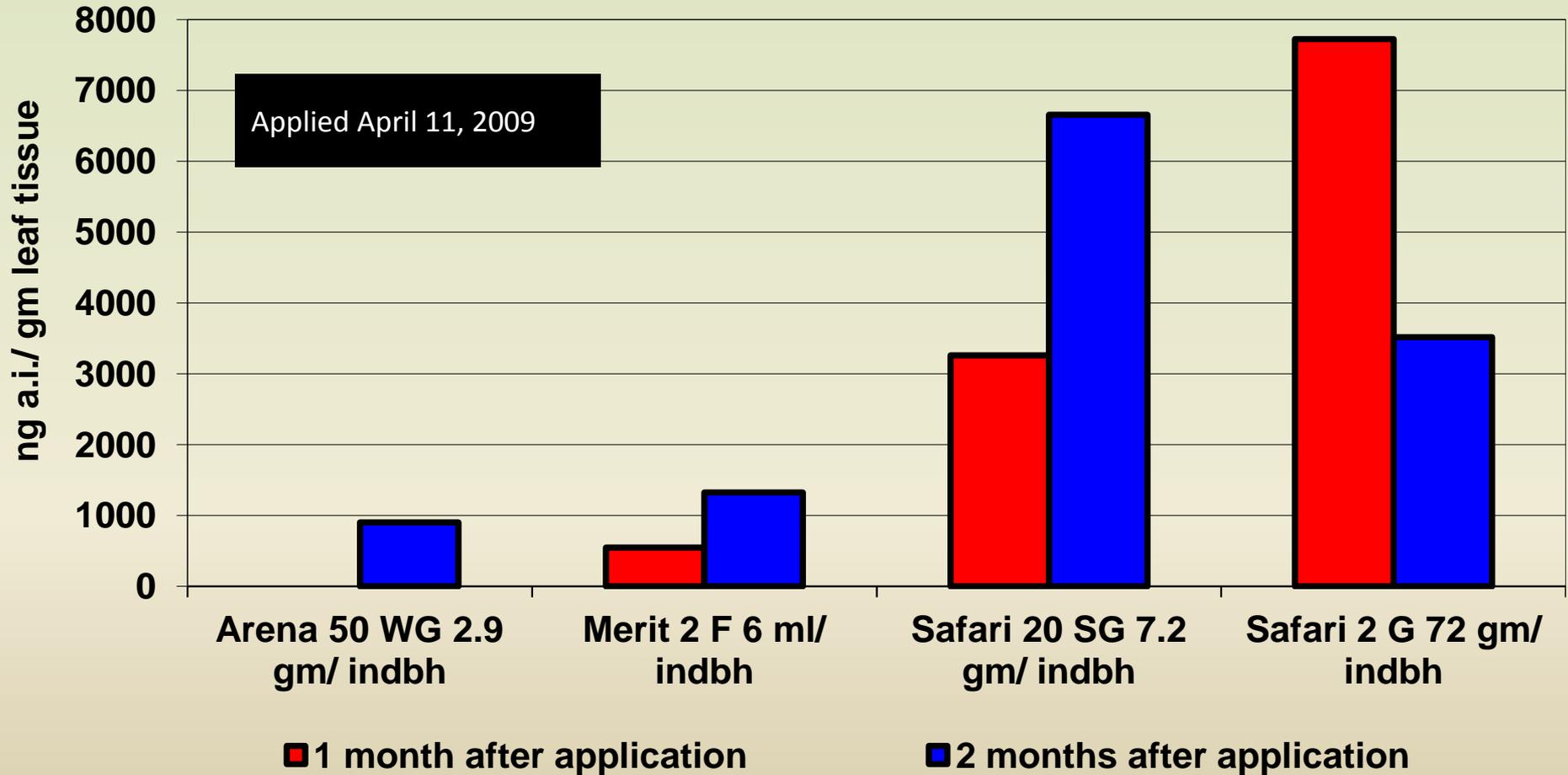




[http://extension.usu.edu/files/publications/publication/NR\\_FF\\_020pr.pdf](http://extension.usu.edu/files/publications/publication/NR_FF_020pr.pdf)

# Neonicotinoid Uptake

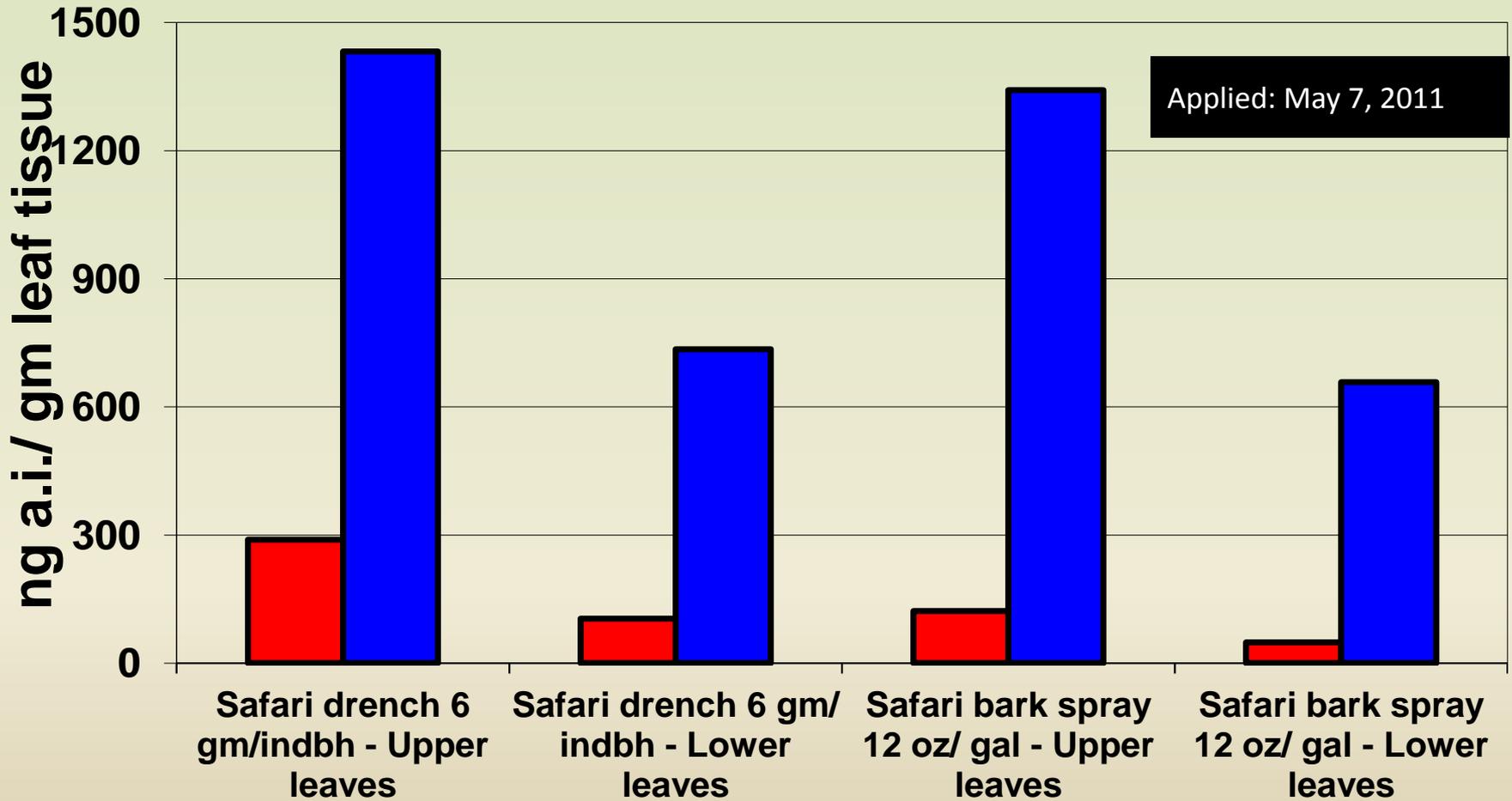
Royal Palm (25-30 ft) – Soil Application



Dr. A. D. Ali (Davey Tree), Walter Albeldano (Valent USA Corp).

# Safari Uptake into Foliage

## Mexican Fan Palm (13" dbh)



■ 14 days after application ■ 28 days after application



# Neonicotinoid Uptake in Coconut Palms

- Product gets into both older (lower) leaves and newer (upper) leaves
- Reduced amount of product in lower leaves
- Soil drench, trunk injection and bark spray all work
- More rapid response from trunk injection and bark spray
- Residual:
  - Trunk application – 6 to 9 months
  - Soil application – 9 to 12 months
  - Imidacloprid has slower uptake but longer residual than dinotefuran

# Palm Trunk Injections

Dr. Monica Elliott, Plant Pathologist and Palm Specialist  
UF/IFAS, Fort Lauderdale REC

**Do NOT inject palms with *any*  
product unless there is a  
legitimate reason to do it**

# Palm Trunk Injections

Dr. Monica Elliott, Plant Pathologist and Palm Specialist  
UF/IFAS, Fort Lauderdale REC



Palm trunks do not compartmentalize wounds.  
Some palm trunks “bleed”.

# Palm Trunk Injections

Dr. Monica Elliott, Plant Pathologist and Palm Specialist  
UF/IFAS, Fort Lauderdale REC

## Are they necessary?

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- Antibiotics (OTC): YES
- Fungicides: Yes, but do they work?
- Insecticides: No
- Nutrients: No, except for very severe manganese (Mn) deficiency

# Palm Trunk Injections

Dr. Monica Elliott, Plant Pathologist and Palm Specialist  
UF/IFAS, Fort Lauderdale REC

## Insecticides

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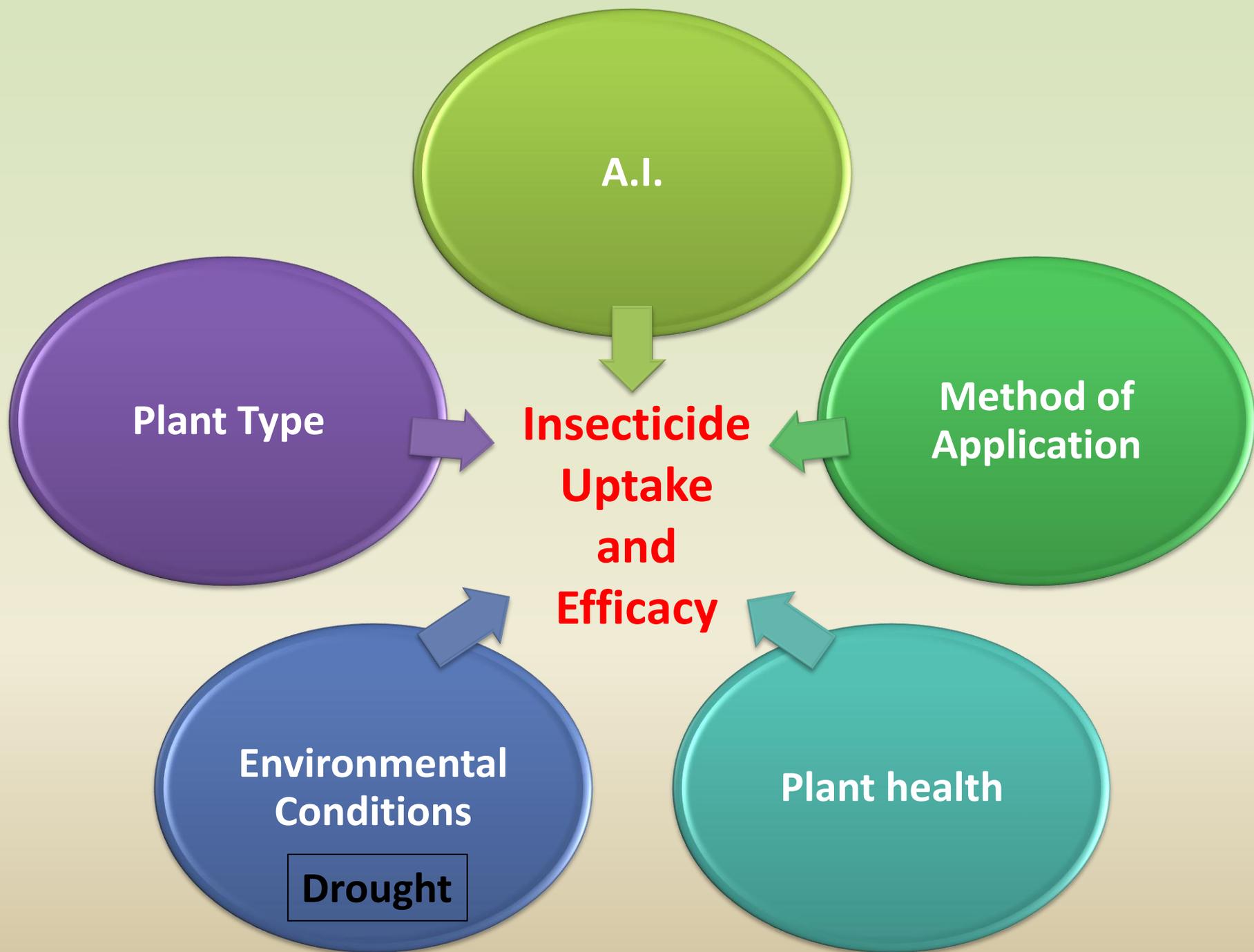
- Trunk injections do not appear to be any more effective than soil/root applications, but have faster in uptake
- Soil/root applications are not detrimental to the environment due to the massive palm root system

# Palm Trunk Injections

Dr. Monica Elliott, Plant Pathologist and Palm Specialist  
UF/IFAS, Fort Lauderdale REC

## Do injections lead to new insect or disease problems?

- None observed in > 30 years of trunk injections with OTC antibiotic for Lethal Yellowing; some concern for Thielaviopsis trunk rot
- As long as injections are done in the lower third of the trunk, you are injecting into lignified wood.
- If palm trunk is shorter than 5 feet, use injections with caution.



# Insecticide Resistance



- Resistance to insecticides - not a new problem
- Ongoing efforts with pyrethroids and **neonicotinoids**, the two biggest selling classes of insecticides
- Repeat application (particularly in multiple generations)
- Exposure to sublethal (less than optimal) pesticide rates

# Arthropods Prone to Resistance Development



**Mites**



**Aphids**



**Whiteflies**



**Thrips**

- Many generations per year
- Exposure of multiple generations to a pesticide
- Produce many offspring
- Limited dispersal

# IRAC Guidelines for Resistance Management of Neonicotinoids

1. Always use recommended label rates and spray intervals with appropriate application equipment
2. Rotate with different MoA
  - Use a foliar product when re-infestation occurs, with a different MoA after a soil application of a neonicotinoid
3. Use suitable rotation partners
  - Pesticide mixtures (premix or tank mix) – used to increase the spectrum of pests controlled or to prevent the development of resistance
  - Do not overuse; same rules of resistance apply

# IRAC Guidelines for Resistance Management of Neonicotinoids

4. Targeting different pests in the same crop
  - When two species overlap, use rate for the more difficult to control species
5. Do not control a multi-generation pest exclusively with neonicotinoids
  - True for landscapes (?)
6. Use neonicotinoids so they complement the prevalence of beneficial organisms
  - i.e. soil applications help conserve the above ground beneficial organisms

# IRAC Guidelines for Resistance Management of Neonicotinoids

7. Never use neonicotinoids for follow up where resistance has already reduced effectiveness
8. Use of non-specific products helps to prevent the development of resistance
  - i.e. oils, soaps, biologicals
9. Good horticultural practices should be applied with physical and biological pest control methods
  - i.e. scouting and monitoring, sanitation, proper fertilization, watering, etc.

# IRAC Guidelines for Resistance Management of Neonicotinoids

## 10. Crop-pest host management

- Regional and local expert recommendations about pest patterns and management

## 11. Integrate escape crops

- Escape crops not treated with neonicotinoids form a reservoir for susceptible pest populations
- Landscape – a giant “escape” crop ???

## 12. Monitor problematic pest populations

# Resources on Insecticide Resistance

- Managing Insecticide and Miticide Resistance in Florida Landscapes - <http://edis.ifas.ufl.edu/in714>
- Management of Insect and Mite Resistance in Ornamental Crops - <http://edis.ifas.ufl.edu/in715>
- A Dresser Drawer Method of Managing Insect and Mite Resistance in Ornamentals - <http://edis.ifas.ufl.edu/in773>
- IRAC's Insecticide Mode of Action classification - <http://edis.ifas.ufl.edu/pi121>

# Neonicotinoids and Pollinators

- Pollinators are essential to the production of more in 85 crops.
- Honey bees are relied on to perform most of the commercial pollination
- Neonicotinoids are toxic to bees
- Concern for long-term sublethal effects
- Implication in Colony Collapse Disease



# New Report on Honey Bee Health

## USDA and EPA 2013

- There are multiple factors playing a role in honey bee colony decline
- Forces impacting honey bee health are complex
  - Parasitic Varroa mite – major factor
  - Bee viruses – major factor
  - Poor genetic diversity
  - Poor nutrition among honey bee colonies
  - Need to determine actual pesticide exposure and effects to bees in the field



# Neonicotinoids and Pollinators

- Pollinators are at risk the most when the vegetation is blooming.
- Observe application timing on the label relative to the blooming stage of crop and other plants.
- The right timing may be reduced by extended bloom or unfavorable weather conditions.
- Evening or nighttime applications are generally the least harmful to honey bees.



# Neonicotinoids and Pollinators

- Determine your best combination of pest control options.
- Use the recommended pesticide at the lowest appropriate labeled rate with the proper timing and placement.
  - Do not use amounts below the labeled rate.  
Loss of control, development of pest resistance.



# THE NEW EPA BEE ADVISORY BOX

On EPA's new and strengthened pesticide label to protect pollinators

**PROTECTION OF POLLINATORS**



**APPLICATION RESTRICTIONS** EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.



Look for the bee hazard icon in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

**This product can kill bees and other insect pollinators.**

Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:  
<http://pesticidestewardship.org/pollinatorprotection/Pages/default.aspx>

Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state/tribe, go to: [www.aapco.org](http://www.aapco.org). Pesticide incidents can also be reported to the National Pesticide Information Center at: [www.npic.orst.edu](http://www.npic.orst.edu) or directly to EPA at: [beekill@epa.gov](mailto:beekill@epa.gov)

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.



The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.



Read EPA's new and strengthened label requirements: <http://go.usa.gov/jHH4>

# *The Facts About Systemic Insecticides and Their Impact on the Environment and Bee Pollinators*

By **Richard S. Cowles Ph.D.**

Connecticut Agricultural Experiment Station

Is imidacloprid safe to use for controlling insect pests feeding on urban trees? Are insecticides like imidacloprid responsible for Colony Collapse Disorder of honey bees? This article will try to provide some guidance and respond to these questions.

## **Neonicotinoid Insecticides and Arboriculture**

Imidacloprid is one of a growing class of insecticides (neonicotinoids) that have, since the announcement of their discovery in 1989, become mainstays in agricultural, pest control and landscape pest management. Two active ingredients of this class are commonly used in arboriculture: imidacloprid (CoreTect, Merit or Xytect) and dinotefuran (Safari and Transtect). One of the rea-

these large trees. Sadly, these trees were only treated once (in 2002), and recently died because the treatment was not continued. Research has shown that the effective dosages for imidacloprid are exponentially related to the diameter of the tree trunk. As trees increase in size they require higher insecticide dosage rates to fully protect the tree. This has been demonstrated in research trials using soil applied imidacloprid on hemlocks for control of hemlock woolly adelgid<sup>1</sup> and on ash trees for control of emerald ash borer.<sup>2</sup> Exploring the relationship between minimum effective dosage and the size of trees for various insect pests should be a fertile subject for further study. A deep understanding of the dose/tree size/pest relationships can lead to optimal use of these insecticides in the environment and therefore reduce

<http://www.ctpa.org/EAB%20Files/Clippings2010.pdf>

# Neonicotinoids and Edible Plants

- Application to fruits
  - Must be on the label to use on edible plants
- Application to coconuts
  - Landscape: ornamental vs edible plant
  - If the label states you cannot use on edible plant – cannot legally use
  - Most state to not eat for one year after application

# Systemic Insecticides

## What Works Best?

- Insecticide
  - All the neonicotinoids (some can work faster but may not last as long)
- Methods
  - All the methods work
  - Trunk applications work faster than soil applications but may not last as long
  - Foliar sprays are not recommended for long term control (do not last long)

- **How long will an insecticide treatment last?**
  - *Foliar treatments (most) – 3 to 6 weeks*
  - *Systemic drench – 9 to 12 months*
  - *Systemic trunk spray – 6 to 9 months*
  - *Systemic trunk injection – 6 to 9 months*
- **Note:** *control of whiteflies on gumbo limbo trees has not been consistent regardless of insecticide or method*
- **Note:** *duration of control is affected by rate, tree condition and environmental conditions*

- **Which is better, soil or trunk application?**
  - *Neither – need to fit the method to your situation. Trunk applications are typically faster but may not last as long*
- **Is there internal trunk damage from injections?**
  - *There is wounding. Sometimes reduced aesthetics. Poor application can create more damage (i.e. trunk cracking, bleeding)*
- **Should a penetrant be used with the basal bark treatment?**
  - *It has not been recommended by the manufacturer; some users believe it has helped.*

- **I am treating my trees with an insecticide but my neighbor is not.**
  - *Using the systemic insecticides can protect your trees from new attacks*
- **Should I treat all the trees on my property**
  - *No. Not all trees are susceptible even if they have some eggs. Treat the “favorites” and if the infestation is heavy consider treating trees near the heaviest infested trees*
- **Will I always have to use an insecticide?**
  - *No. You should never retreat with an insecticide without evaluating the current population to determine if the application is necessary*

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