Understanding Neonicotinoid Insecticides

CPS Seminar

May 14, 2009

Arnold H. Hara
University of Hawaii at Manoa
College of Tropical Agriculture & Human Resources
875 Komohana St. Hilo, Hawaii
E-mail: arnold@hawaii.edu
Phone: 808 959-5199
Website: http://www.ctahr.hawaii.edu/haraa/index.asp

There are 33 total slides.
Click on “Outline” to close left pane.
Use navigational buttons at the bottom of the slide
OR
Click on “Slide Show” at bottom right, then click on each slide to advance or right-click mouse to back up to previous slide or close slide show.

This presentation is partially based on data and information graciously provided by:

Dr. Casey Sclar
Longwood Gardens, Inc.
Kennett Square , PA

Dr Frank J. Byrne
Dept of Entomology,
University of California,
Riverside, CA

What will this presentation cover?

*What are Neonicotinoids?
*History of Neonicotinoids
*Properties of Neonicotinoids
  UV sensitivity
  Water solubility
  Residual Activity
  Systemic Movement to leaves and flowers
*Spectrum of Insect Control
  Sucking Insects: aphids, scale insects, mealybugs, whiteflies, lacebugs
  Chewing Insects: beetles, caterpillars, grubs,
*Resistance Management: Rotation, Compatibility
*Reality

Evolution of Insecticides

1940-50's

Chlorinated hydrocarbons

DDT, Chlordane, Dieldrin, Mirex

1960-70's

Organophosphates & Carbamates

Dimethoate, Diazinon, Dursban, Orthene

1980-90's

Pyrethroids (synthetic)

Mavrik, Tame, Tempo, Decathlon, Talstar

1990-2000's

Reduced-Risk Insecticides

Naturalytes

Conserve, Avid, Ultiflora, Neem

Insect Growth Regulators

Distance, Enstar, Talus

Neonicotinoids

Merit, Marathon, Flagship, Safari, TriStar

NEONICOTINOID INSECTICIDES

Acetamiprid

Arena®
INSECTICIDE

Clothianidin

Dinotefuran

imidacloprid

imidacloprid

imidacloprid

ADMIRE®
PRO
Systemic
Protectant

imidacloprid

***Neonicotinoids** act on the nervous system of insects with very low toxicity to mammals and minimal environmental impact and therefore, considered a reduced-risk pesticide.

*Neonicotinoids are among the most widely used insecticides worldwide.

*The mode of action of neonicotinoids is similar to the natural insecticide nicotine. In insects, neonicotinoids cause paralysis which leads to death, often within a few hours.

*They bind at a specific site, the nicotinic receptor, and there are no records of cross-resistance to the carbamate, organophosphate, or synthetic pyrethroid insecticides, thus making them important for management of insecticide resistance

Neonicotinoid Insecticides

Spectrum of Insect Control

Sucking insects

- Aphids
- Lace Bugs
- Leafhoppers
- Mealybugs
- Plant Bugs/Hoppers
- Psyllids
- Scale Insects
- Spittlebugs
- Thrips
- Whiteflies

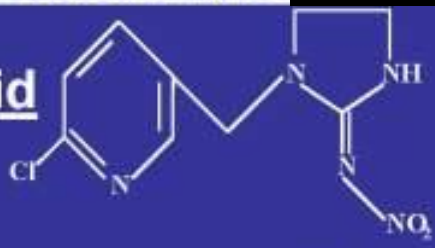
Chewing insects

- Beetles
- Borers
- Mole Crickets
- Gall Wasps
- Grubs
- Leafminers
- Termites
- Weevils

Neonicotinoids

Chloronicotinyls

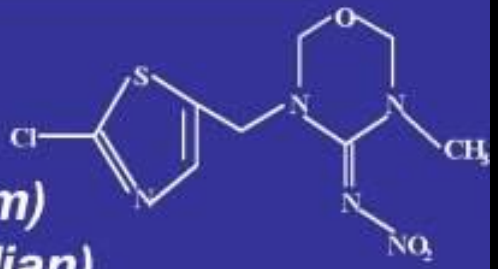
Imidacloprid
Many…



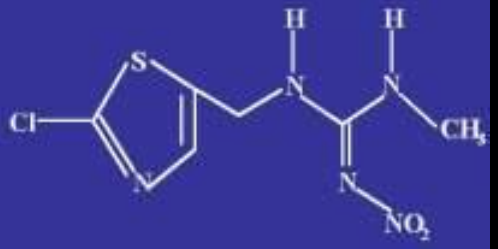
Acetamiprid
(Assail)
(Tristar)

Thianicotinyls

Thiamethoxam
(Actara, Platinum)
(Flagship, Meridian)

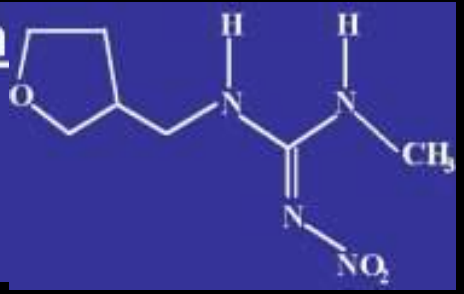


Clothianidin
(Poncho)
(Arena)



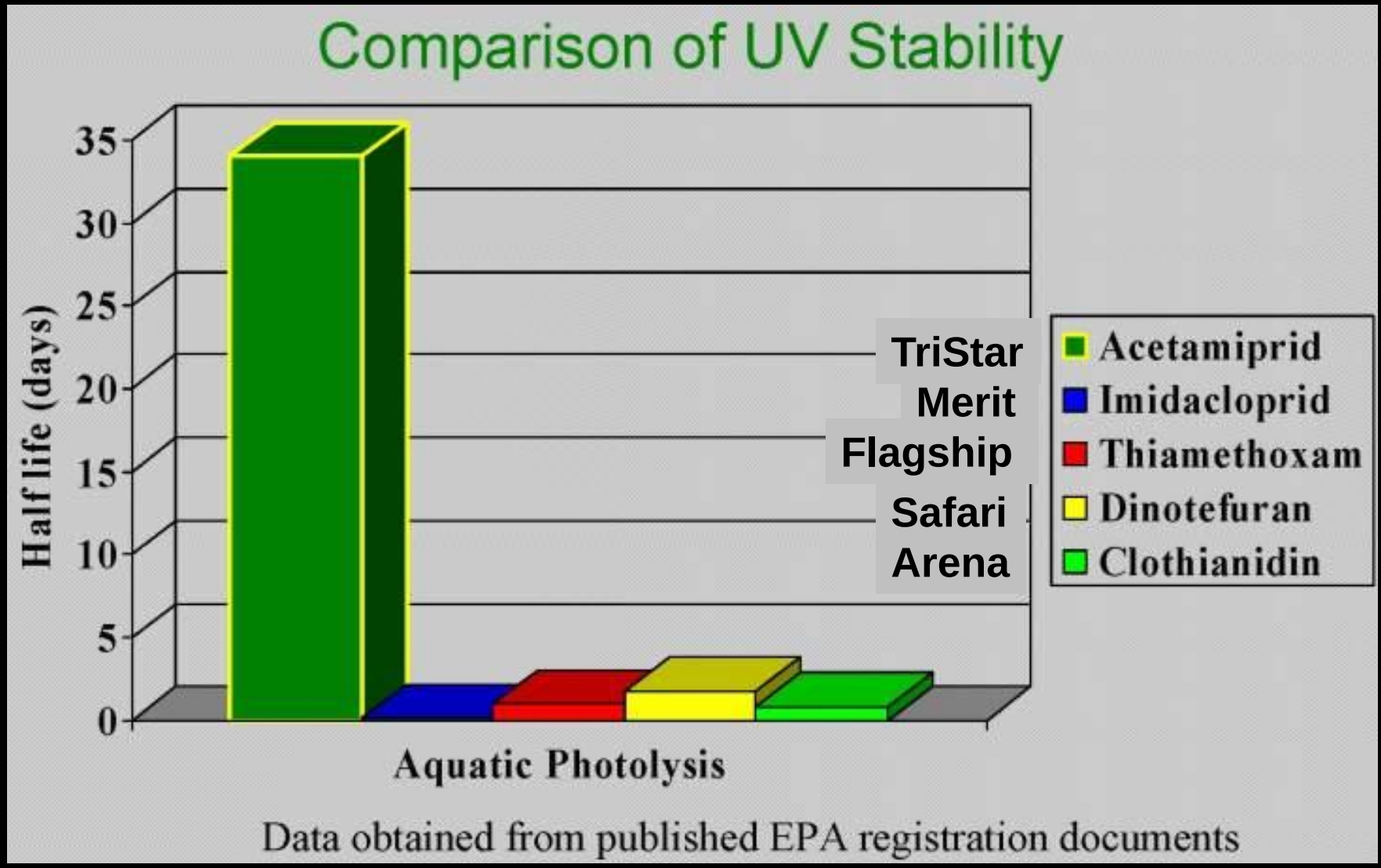
Furanicotinyl

Dinotefuran
(Venom)
(Safari)



Slide info from F. Byrne

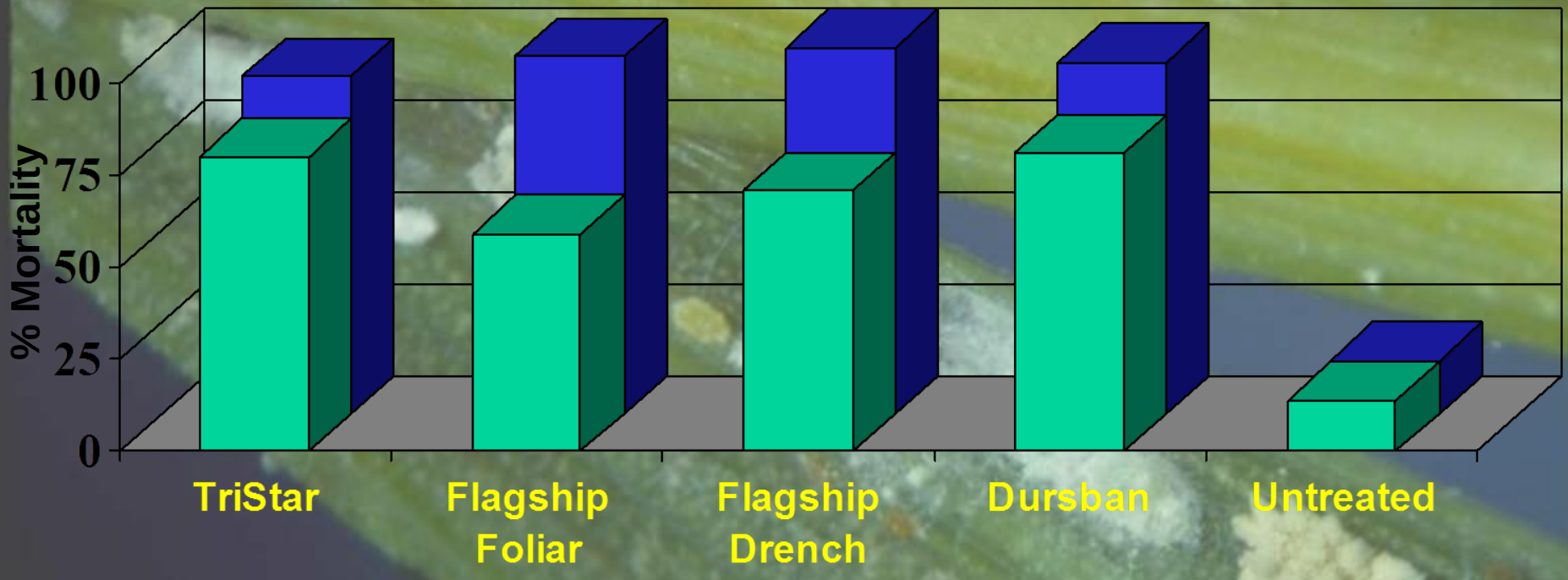
*Different types of neonicotinoids have unique *uv* resistance, water solubility, binding with soil & pest spectrum characteristics.



TriStar is registered for foliar use only and the most uv stable of all neonicotinoids.

Slide Credit: R. Fletcher

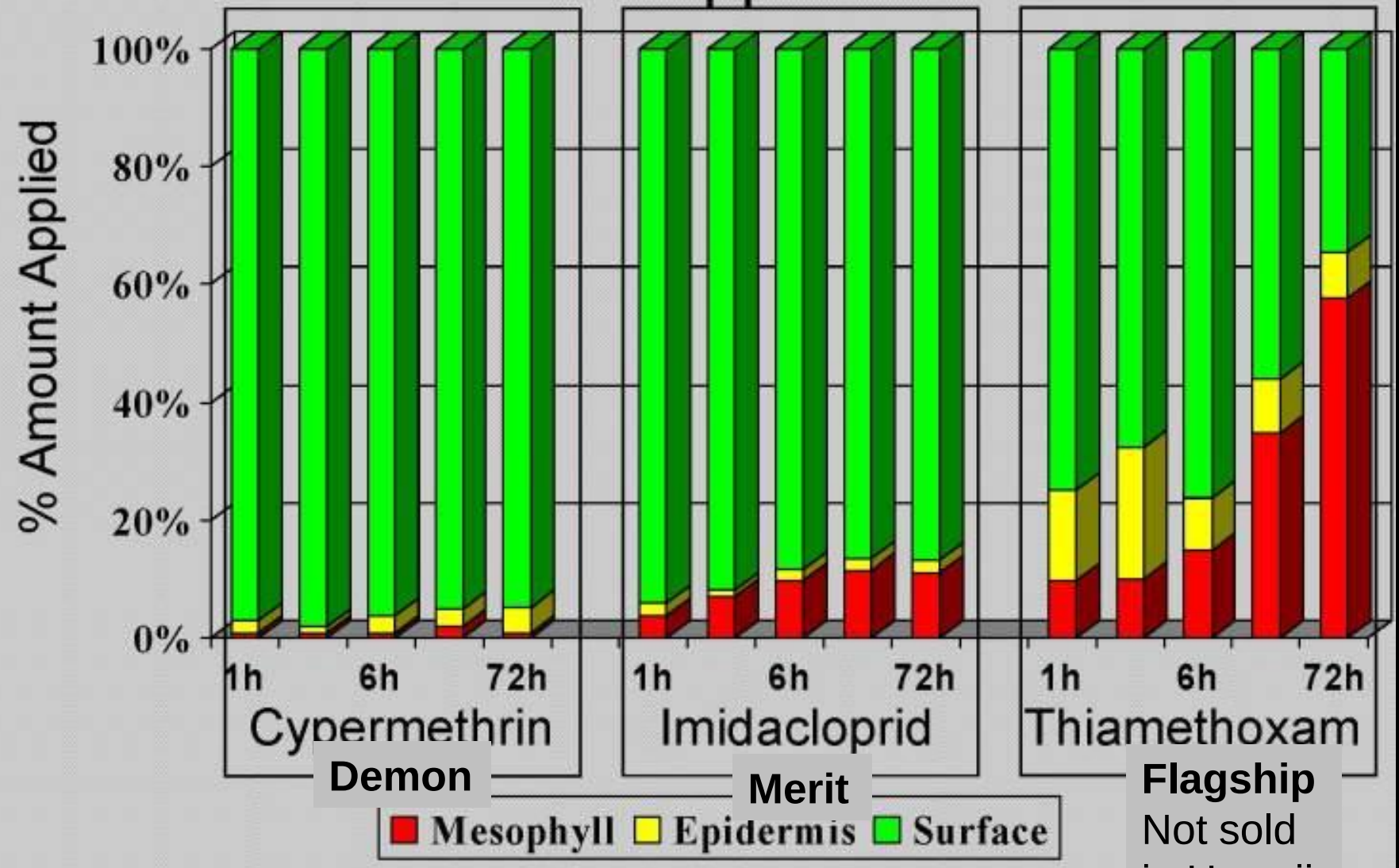
TriStar and Flagship Against the Coconut Mealybug, *Nipaecoccus nipae*



TriStar = acetamiprid

Flagship = thiamethoxam
(Not sold in Hawaii)

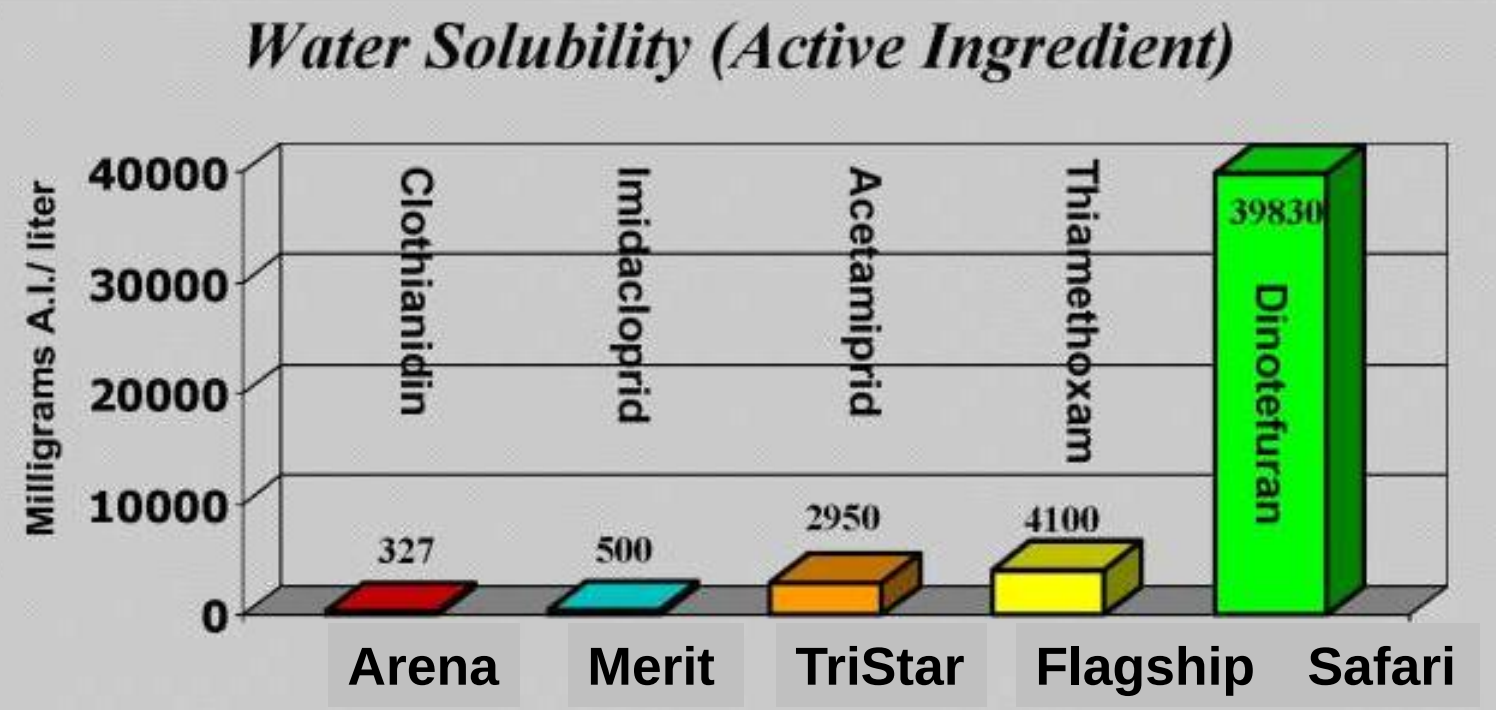
Rate of Uptake Into Leaf Parts After a Foliar Application



Not sold in Hawaii

Slide Credit: N. Rechcigl

Relative Water Solubility of Neonicotinoids:

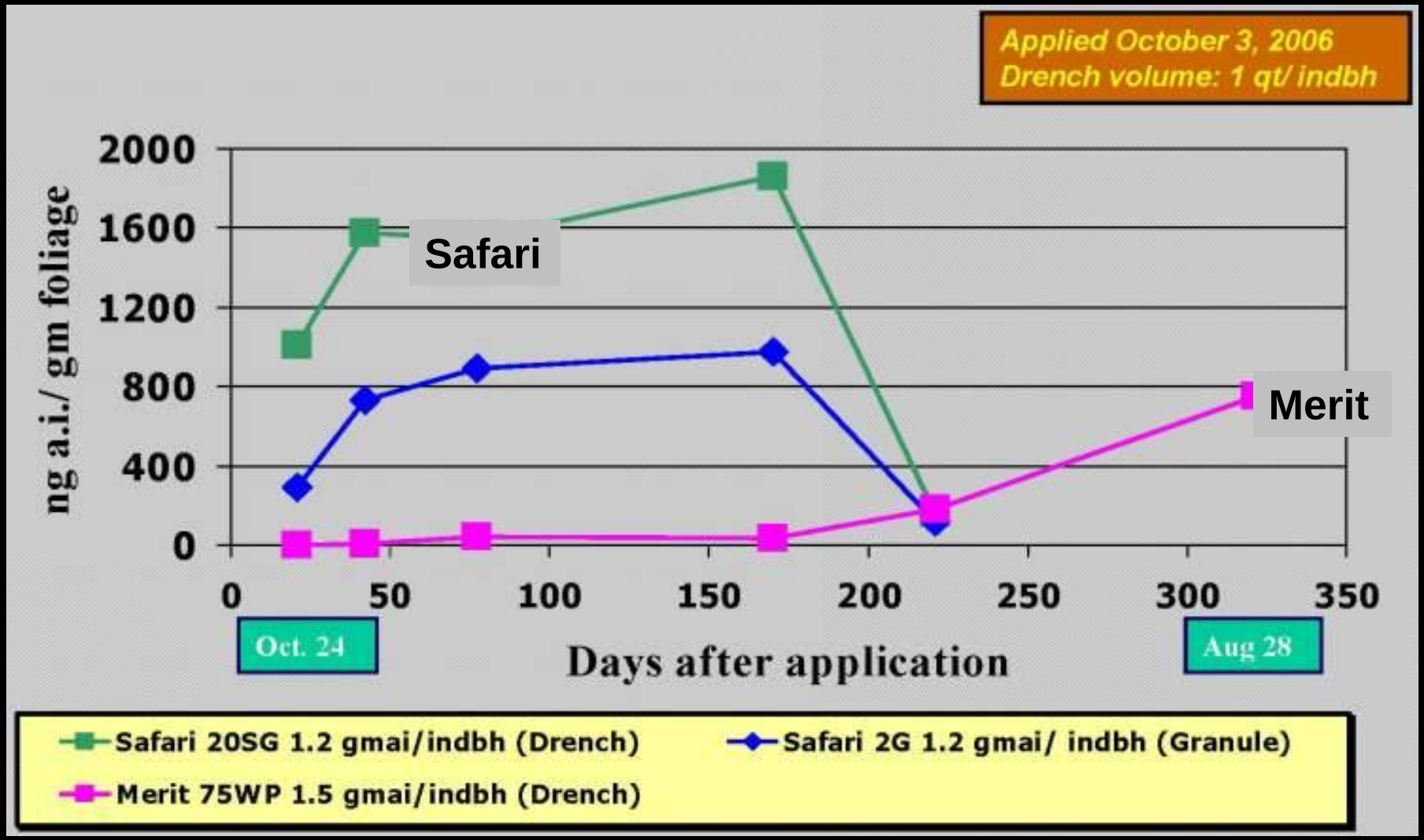


Information sources
Clothianidin (Celero), Acetamiprid (Tristar), Dinotefuran (Safari) – EPA Pesticide Fact Sheet
Imidacloprid (Marathon), hiamethoxam (Flagship) – MSDS for Products

Slide information courtesy J. Chamberlin

Neonicotinoid Uptake in Hemlock

12-24”DBH Hemlock, Cashiers, NC



Safari (dinotefuran) as compared with Merit (imidacloprid)

* Safari is similar to Merit/Marathon, but more water soluble for quicker systemic uptake in plants.
* Systemic activity is not as long-lasting.
* Effective against whiteflies, aphids, soft scale. wax scales, thrips, fungus gnats, similar to Merit.
* Also effective against armored scales and mealybugs.
* Apply as a foliar or drench application.

Safari (dinotefuran) against Mealybugs at a Hilo nursery

citrus mealybug

Foliar and drench applications of Safari were tested at the labeled rate on these infested plants.

Results of Safari Trial

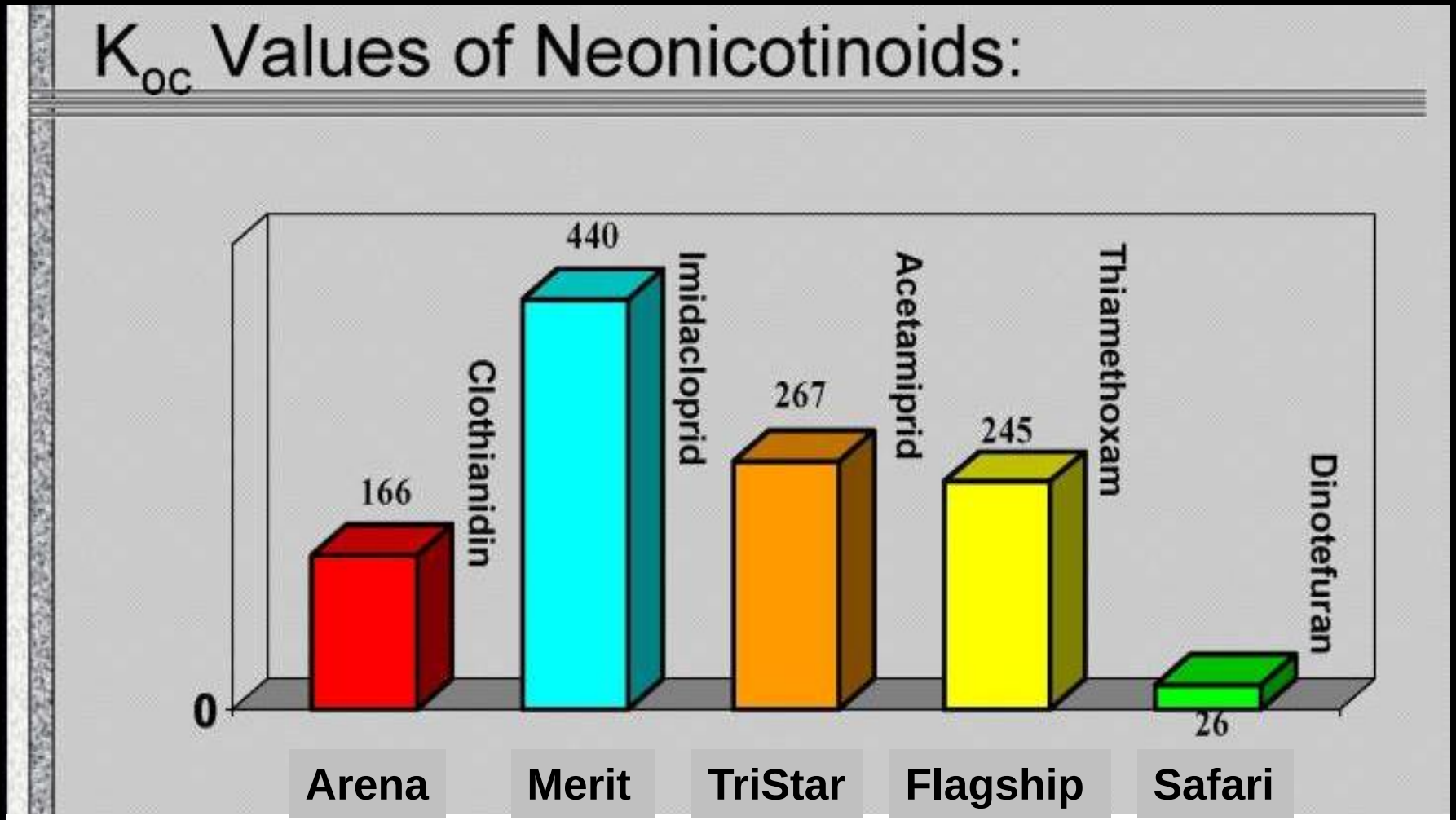
Jan 2005

*Foliar application resulted in mealybug-free marketable plants 6 weeks after application in 8 of 10 plant cultivars tested.

*Drench application resulted in mealybug-free marketable plants 6 weeks after application in 10 of 10 plants cultivars tested.

Soil Adsorption Coefficient

A measure of how tightly the pesticide binds or sticks to soil particles.



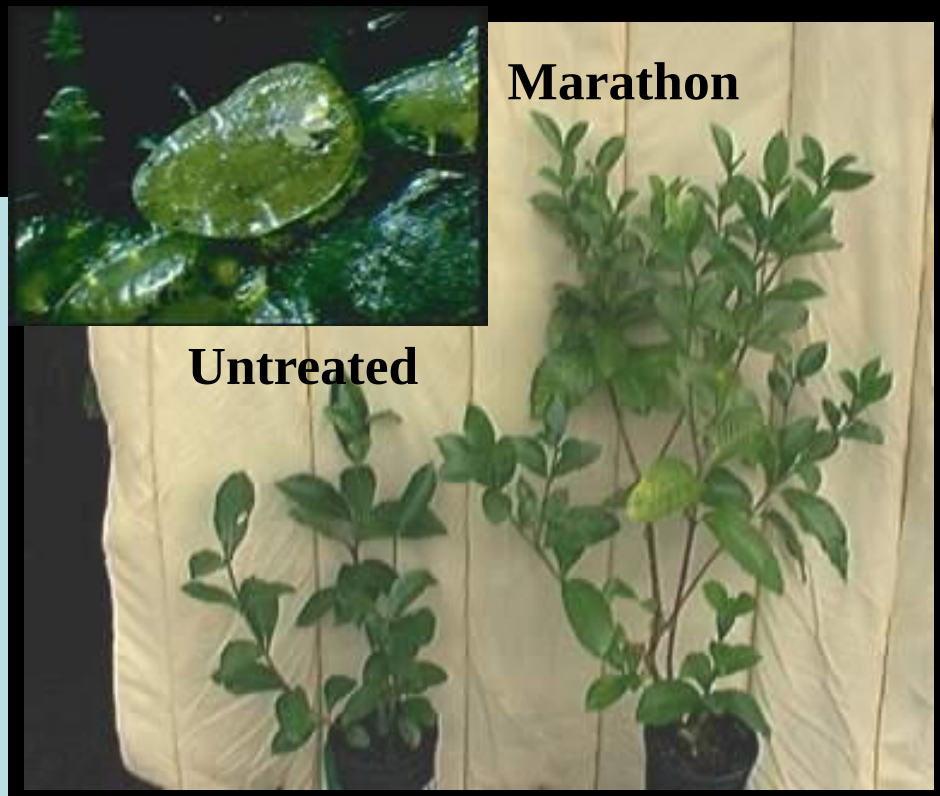
High value means it is strongly adsorbed onto soil and organic matter and does not move throughout the soil *(EPA Pesticide Fact Sheets).*

Merit (Marathon) is highly effective against aphids, Chinese rose beetle, azalea lacebug, soft scales & whiteflies, and moderately effective against mealybugs.

Green scale,
Coccus viridis

Applied as a drench, by 21 DAT >90% mortality of green scales observed on gardenia plants. Control lasted for approximately one year.

Growth difference of gardenia due to control of green scale.



Imidacloprid against Red Ginger Pests

	WEEKS OF EFFECTIVE CONTROL (>95%):	
FIELD TREATMENT	MEALYBUGS	BANANA APHIDS
MERIT (1 application)	17	53
DURSBAN (3 applications)	3	4

Dying Chinese rose beetles after feeding on rose plant drenched with Merit about 2 weeks earlier.

New growth with no beetle damage

* Drench application must be applied to the feeder roots that has adequate soil moisture.
* Subsequently, must be irrigated to assure uptake
* Liquid fertilizer added to insecitcide may assist uptake.
* Competition by groundcovers or turf contributes to effective uptake.

Reduced-Risk Insecticides Against Papaya mealybug

Foliar applications

- Applaud (buprofezin; 12 oz/acre)
- Provado (imidacloprid;8oz/acre)

Drench Application

- Admire (imidacloprid; 32 oz/acre) was applied in 5 gal of water to the roots by treating the area 3 ft in all directions from the base of the tree.

Bark Application

- Pentra-Bark surfactant (2% of solution) and Admire (imidacloprid; 32 oz/acre) were applied to the tree trunks with a sprayer until runoff (200ml/tree).

PENTRA-BARK®

BARK PENETRATING SURFACTANT

PRINCIPLE FUNCTIONING AGENTS:

Alkiphanol ethoxylate, polysiloxane polyether copolymer, propylene glycol	99.8%
CONSTITUENTS INEFFECTIVE AS A SPRAY ADJUVANT	0.2%
TOTAL	100.0%

All ingredients are exempt from tolerance requirements under 40 CFR 180.

U.S. EPA 000000

CAUTION

KEEP OUT OF REACH OF CHILDREN

Harmful if swallowed. Causes moderate eye irritation. Avoid contact with eyes, skin or clothing. Wash thoroughly with soap and water after handling.

Personal Protective Equipment: Wear protective eyewear, long-sleeved shirt and long pants, shoes plus socks when mixing or applying PENTRA-BARK®.

FIRST AID

If Swallowed: Call a physician or Poison Control Center immediately. Do not induce vomiting, unless told to do so by a poison control center or doctor. Have person sip a glass of water if able to swallow.

If on Skin: Remove contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment advice.

If In Eyes: Flush with water for at least 15 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.

If Inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth to mouth if possible.

GENERAL INFORMATION

PENTRA-BARK® is a superior nonionic wetting agent, designed for improving penetration through bark of water based basal applications. **PENTRA-BARK®** may be used in agriculture, horticulture, industrial, and forestry operations. It is designed for fast spreading, uniform distribution and absorption of spray on leaf and stem surfaces. **PENTRA-BARK®** may be used with most pesticides and fertilizer products (see cautionary statements under directions for use). Optimum application and consequent effects can be influenced by many factors. It is recommended that the spray be observed and adjuvant rates be adjusted accordingly. During application, insure thorough coverage without excessive runoff.

DIRECTIONS FOR USE

PENTRA-BARK® is a nonionic organosilicone wetting agent designed for use in certain agricultural and horticultural uses where a nonionic surfactant is recommended. Suggested Rates for the use with various categories of chemicals are as follows:

Chemical Group	Ounces of PENTRA-BARK® to add per 100 gal. of spray mixture
Insecticides, Miticides & Fungicides	6 to 32 fl. oz
Herbicides	12 to 64 fl. oz
Glyphosate formulations without added surfactants	12 to 64 fl. oz
Defoliants & Desiccants	12 to 64 fl. oz
Fertilizers & Micronutrients	4 to 32 fl. oz

NOTE: Carefully read and follow the specific directions contained on the label of the chemical used. Before adding PENTRA-BARK® to spray tank mixes or before using with a pesticide or fertilizer where a nonionic adjuvant is not specifically recommended but not prohibited by the manufacturer, the user or application advisor must have experience with the combination or must have conducted a phytotoxicity test of their own. For local recommendations, consult a competent agricultural authority.

Basal Bark Treatment: PENTRA-BARK® is specially designed to aid penetration of fertilizers, nutrients, insecticides, fungicides, and herbicides through the bark. Use 1% to 2 1/2% PENTRA-BARK® by volume of spray solution. Consult pesticide label for specific use rates and application method, or contact your Quest Representative.

Aerial Application: When applying aerially, follow pesticide label directions including minimum water volume per acre. Do not substitute PENTRA-BARK® for water required by the pesticide label.

Irrigation Injection: Applications of PENTRA-BARK® through irrigation systems are possible provided the recommended use rates and dilutions are maintained and local, state, and federal guidelines are followed.

Water Penetration of Hard-to-Wet Soils: For most efficient water penetration of hard-to-wet soils and the even distribution of applied moisture, use 1 pint per 100 gallons of water as a spot or area treatment.

NOTE: Not for use with aquatic applications in the State of Washington.

MIXING

Spray mixing and application equipment must be cleaned according to cleaning directions on prior pesticide label before application.

To minimize and help prevent foaming, fill tank 2/3 to 3/4 full of water. Add pesticides and/or fertilizers as directed by label or in the following sequence: 1) Micronutrients and fertilizer; 2) Dry flowables and dispersible granules; 3) Flowables; 4) Water soluble pesticides; 5) Emulsifiable concentrates.

While agitating, add PENTRA-BARK® and mix for 1 to 2 minutes with lower than normal agitation. Continue filling tank maintaining minimal agitation. For most effective results, apply within 36 hours after mixing.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Do not store near heat or open flame. Store in original container.

Pesticide: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration.

NOTICE TO BUYER

To the extent permitted by law, all conditions and warranties and statutory or other rights of action which buyer or any other user may have against Quest Products Corp. are hereby excluded. Quest Products Corp. hereby gives notice to buyer and other users that it will not accept responsibility for any indirect or consequential loss arising from reliance on product information provided by Quest Products Corp. or on its behalf unless it is established that such information or advice was provided negligently and that the product has been used strictly as directed. Quest Products Corp's. liability shall in all circumstances be limited to replacement of product or a refund of the purchase price thereof.

Pentra-Bark® is a registered trade mark of Quest Products Corporation.

Patent pending.

Quest Products Corp.
601 Countryside Drive
Louisburg, Kansas 66053
Ph: 913-837-3089
Fax: 913-837-5389
www.questproducts.us

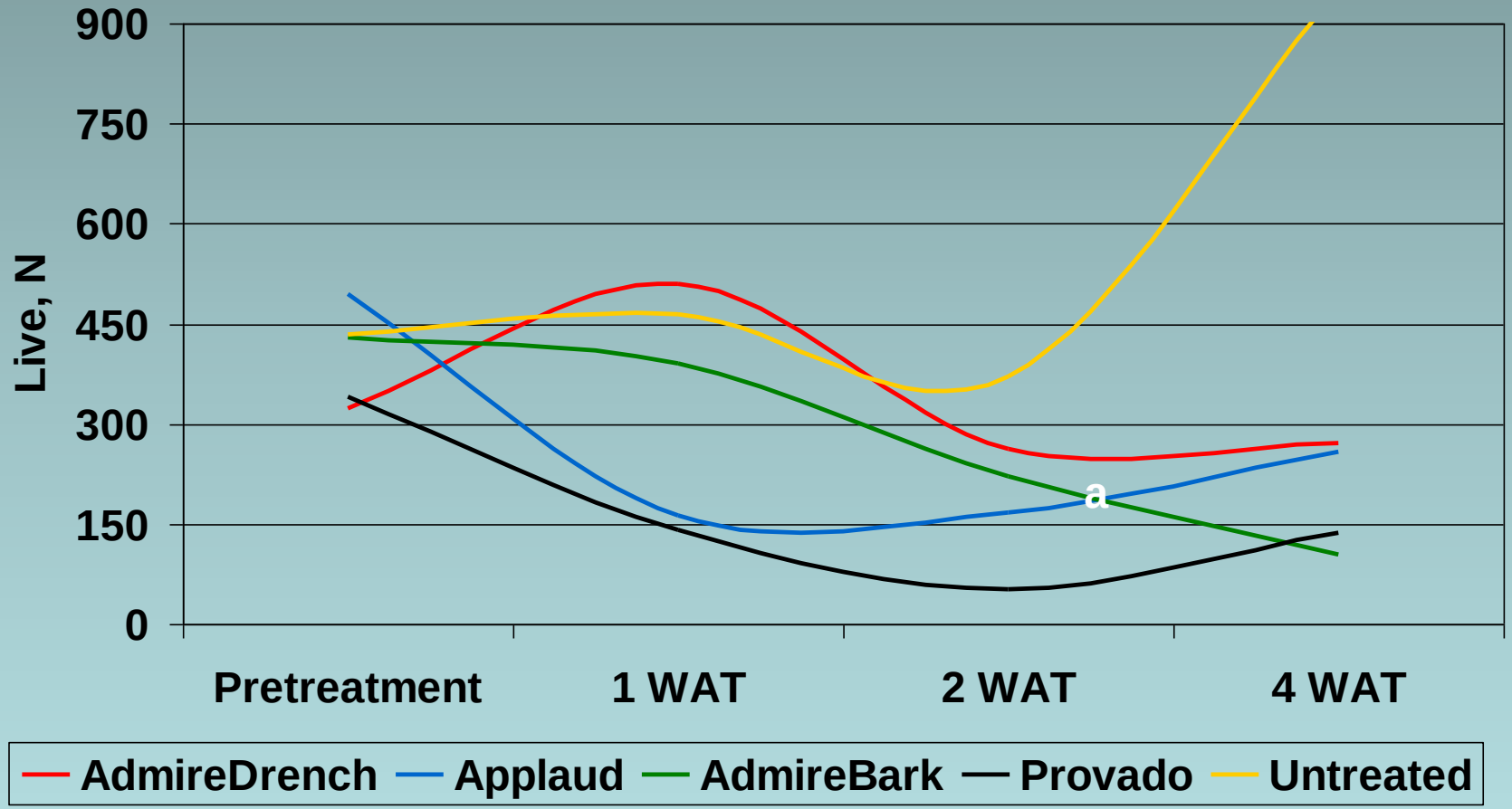
*Pentra-Bark surfactant (2% of solution) & Admire (imidacloprid; 32 oz/acre)

*Applied to the tree trunks with a hand sprayer until runoff (200 ml/tree)

http://www.questproducts.us/

Imidacloprid (Admire, Provado) and Buprofezin (Applaud/Talus) Against the Papaya Mealybug

Samples consisted of one “finger” (approx 12 in^2) from mature palmate papaya leaves.



Safari bark treatment has also shown to be effective and will be labeled.

D. Ogata

Erythrina = Wiliwili Gall Wasp

Spread was like a wild fire

- **First described in 2004 causing severe damage in Taiwan and Singapore.**
- **First found on Oahu in April 2005.**
- **Found in Big Island, Kona, Kauai, and Maui in July 2005.**


First Study Site in Pearl City, HI
Tall wiliwili 20-30” tall, 5-12” diam
Injection and Drench Treatment: Aug 03, 2005


Drilling
Injecting
Applying Treaments
Trenching
Drenching

Injection Systems Evaluated

12 Weeks After Treatment

Treated trees showing concentration effect with different injection system and imidacloprid formulations

Imidacloprid Injection & Drench Efficacy on Tall Erythrina

20 Weeks After Treatment

Formulation/ Injection System	AI (mg)/ Inch Diameter	Emerged Wasps/g Tissue	Imidacloprid Concentration µg/g
Untreated	-------	15 a	0.0 a
Imicide10%AI/ Mauget Capsules	0.17	3 b	0.5 a
Pointer 5% AI / ArborSystems Wedgle	0.03	3 b	3.0 a
Merit 200 SL 17.1%AI / Arbor Jet Tree IV	0.94	0.4 c	36.0 b
IMA-jet 5% AI / Arbor Jet Tree IV	0.43	0.1c	235.0 c
Merit 2F 21% AI Root Drench	1.44	16 a	0.2 a

The IMA-Jet had the least gall severity rating and wasp emergence and delivered the highest concentration of imidaclorpid

Application of Merit as a “Tablet”

*Insert the “pill” in the pot media and solve your pest problem.

* >20 weeks of whitefly control
* >12 weeks of thrips control

The Reality

* Neonicotinoid insecticides are not cheap and require specific knowledge of the pest and the characteristic of the specific neonicotinoid (TriStar, Merit, Safari) for its cost-effective use.
* Proper drench, injection, or “pill” applications are critical for effective systemic uptake.
* Neonicotinoids are able to provide excellent control of some pests that are difficult to control with pyrethroids, organophosphates and carbamates, including aphids, whiteflies, erythrina gall wasps, mealybugs, soft scales and armored scales.


THANK YOU!
08 Feb 14