NAICC 2019 Annual Meeting and Ag Pro Expo
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Savannah, GA

Entomology: A Perspective on Insecticide Efficacy Research

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Entomology research and extension from South Texas to South Florida

- **Field crops and vegetables**
  - Sugarcane, rice, field corn, sorghum, soybeans
  - Sweet potatoes, sweet corn, lettuce

Two main types of activities result in a successful trial

- **Planning the trial based on protocol objectives**
  - Determining resources needed
  - Developing experimental design in space and time

- **Conducting the trial**
  - Practical aspects of obtaining the results

What does the protocol tell us?

- **Scale of the study**

  - Non-replicated demonstration

  Acceptable for visual support of previous results
  Demonstration of new application technologies
  No additional value

  - Replicated demonstration or large plot trial (≥ 2 reps)

  Mimics commercial production practices
  Results can be analyzed and used for inference
  Often impractical and sometimes expensive

What does the protocol tell us?

- **Scale of the study**

  - Conventional small plot evaluation (most common)

  Numerous can be evaluated under the same conditions

  Results can be analyzed and used for inference

  Does not always mimic commercial practices

  Effects of treatments can be "diluted"

What does the protocol tell us?

- **Treatments evaluated**
  - Untreated check
  - Standard (commercial or known efficacy)
  - Novel active ingredient
  - Premix of widely used AI
  - New use of a widely used AI
  - Rate
  - New formulation
  - Adjuvant
- **Target crop**
  - Field crops, vegetables, ornamentals

What does the protocol tell us?

- **Target arthropod pests…**
  - **Hemiptera** (stink bugs, aphids, whiteflies, scale insects)
  - **Lepidoptera** (defoliating worms, fruiting structure-eating worms, stalk borers)
  - **Coleoptera** (rootworms, wireworms, defoliating beetles, fruiting structure-eating beetles)
  - **Diptera** (leafminers, fruit flies)
  - **Thysanoptera** (thrips)
  - **Acari** (spider mites, rust mites)

What does the protocol tell us?

- **… and beneficial arthropods**
  - **Natural enemies** (lady beetles, lacewings, minute pirate bugs, assassin bugs, stink bugs, parasitic wasps, ants, spiders, earwigs)
  - **Pollinators**

Photo: B.W. Fuller

Scale of study * Treatments evaluated * Crop * Target arthropods
→ Endless combinations of entomology trials!!!

What to do if you are not familiar with the crop and target arthropod(s)?

- Call an entomologist!
- Review the literature!
  - ESA's Arthropod Management Tests reports
  - Peer-reviewed publications if you have access

ESA's Arthropod Management Tests reports
https://academic.oup.com/amt

Arthropod Management T...

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arthropod management tests

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Latest Issue
Volume 44, Issue 1
2019

Editor-in-Chief
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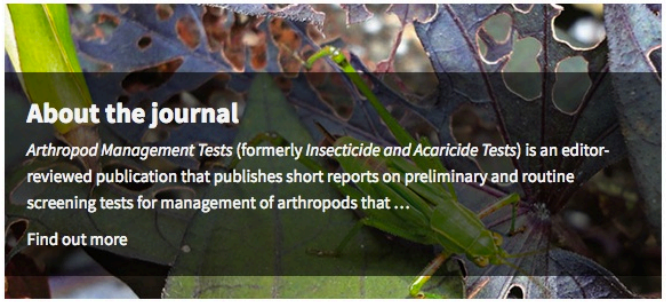

Arthropod Management Tests ARCHIVE
NOW OPEN

Latest articles

Bark and Systemic Insecticidal Control of Acanthococcus (=Eriococcus) lagerstroemiae (Hemiptera: Eriococcidae) on Potted Crapemyrtles, 2017

Efficacy of Insecticides Against Chilli Thrips (Thysanoptera: Thripidae) in Containerized Distylium in Commercial Nursery, 2018

Control of Reniscia tabaci (MED whitefly) on Salvia, 2018

Most read

Control of Woolly Apple Aphid, 2017

Chemical Control of Woolly Apple Aphid, 2017

Efficacy of Insecticides Against Chilli Thrips (Thysanoptera: Thripidae) in Containerized Distylium in Commercial Nursery, 2018

Latest tweets

Entomological Society of America Retweeted

Laura Kraft
@LauraJoanKraft
I'm going to ask a crazy question. @EntsocAmerica Have you ever heard of people doing this with invertebrate pets? Do we need to set up pet take back days? (Or Sci Fair take back days) for invertebrate pets?

15h

Arthropod Management Tests, 2017, 1–1
doi: 10.1093/amt/tsx021
Section E: Vegetable Crops

CORN (Sweet): *Zea mays* (L.), 'Summer Sweet 8102R'

Insecticidal Control of Fall Armyworm on Sweet Corn, 2015*

Philip A. Stansly[1] and and Barry C. Kostyk

University of Florida/IFAS, Southwest Florida Research and Education Center, 2686 State Road 29 North, Immokalee, FL 34142-9515, Phone: (239) 658-3427, Fax: (239) 658-3469 (pstansly@ufl.edu; bkostyk@ufl.edu) and [1]Corresponding author, e-mail: pstansly@ufl.edu

Section Editor: Mark Abney

Corn (hybrid, maize, sweet) | *Zea mays*

fall armyworm | *Spodoptera frugiperda*

Fall armyworm (FAW): Spodoptera frugiperda (J.E. Smith)

FAW is a key pest of sweet corn in Florida with larvae feeding successively in whorls, tassels, silks, and ears. New chemistries are constantly being sought to provide better and more sustainable FAW control. The trial was conducted at the Southwest Florida Research and Education Center in Immokalee Florida on two beds 32 inches wide and 420 ft long on 6 ft centers that were prepared and fumigated with Pichlor 60 EC on 18 Aug. Fertilizer (10-2-10) was incorporated at 100 lbs N, and beds were provided with two drip tape irrigation lines with 8 inch emitter spacing as they were covered with whitefaced polyethylene mulch. Corn was direct seeded 14 Sep at 10-inch spacing with two seeds per hole, and a 7-2-7 liquid fertilizer was injected through the drip using a Dosatron® over the growing season. Five treatments were assigned in an RCB design with four replicates. Each plot contained 40 plant spaces with 10 plant spaces left between plots as a buffer. The center row of the three-bed set was left untreated as a pest refuge and buffer area between treated rows. Applications were made with a high-clearance sprayer traveling at 2.3 mph equipped with 4 ceramic Albuz® "yellow" hollow cone tips each delivering 10 gpa at 180 psi for a total of 40 gpa. This trial was designed to test the products for ear protection only, therefore Xentari (2 lbs) on 7 Oct, Intrepid (8 oz) on 12, 16, and 26 Oct and Belt (3 oz) on 19 and 22 Oct were applied to get plants to the silk stage before initiating comparative treatments (Table 1). The dominant ear on 20 plants was harvested on 17 Nov and graded into three categories: no damage, minor tip damage, and significant ear damage. Marketable ears were weighed as a group.

All treatment programs significantly increased the number of marketable ears compared to the untreated check, and there were no significant differences among them. The two Temitry treatments also reduced the number of culls due to ear damage compared to the check although not compared to the other treatments. No phytotoxicity was observed (Table 2).

Table 1

Product	Rate (acre)	30 Oct	2 Nov	5 Nov	9 Nov	13 Nov
Untreated						
Radiant SC	5.0 oz	×		×	×	
Intrepid 2F	8.0 oz		×			×
Radiant SC	5.0 oz	×		×	×	
Temitry	15.0 oz		×			×
Radiant SC	5.0 oz	×		×	×	
Temitry	30.0 oz		×			×
Radiant SC	5.0 oz	×		×	×	
Declare	1.54 oz		×			×

Table 2

		No. per 20 harvested plants on 17 Nov		
Product	Rate/acre	Marketable ears	Tip damaged	Ear damaged
Untreated		5.25 b	9.00	5.75 a
Radiant SC	5.0 oz	13.00 a	3.25	3.75 ab
Intrepid 2F	8.0 oz			
Radiant SC	5.0 oz	12.25 a	6.25	1.50 b
Temitry	15.0 oz			
Radiant SC	5.0 oz	13.00 a	4.75	2.25 b
Temitry	30.0 oz			
Radiant SC	5.0 oz	12.50 a	4.25	3.25 ab
Declare	1.54 oz			

Means within columns followed by same letter are not statistically different (LSD, $P > 0.05$).

Scholar Google search for peer-reviewed publications (e.g., J. of Economic Entomology, Florida Entomologist, Crop Protection, etc.)

soybean aphid insecticide ...

https://scholar.google.com/scholar?hl=en&as_sdt=1%2C10&q=soybean+aphid+insecticide&btnG=

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Economic threshold for **soybean aphid** (Hemiptera: Aphididae) [PDF] iastate.edu
DW Ragsdale, BP McCornack... - Journal of Economic ..., 2007 - academic.oup.com
... Initial **soybean aphid** colonization across all location-years occurred between 1 June and 23 July ... Peak **aphid** densities typically occurred between late July and late August (Fig. 2) when **soybeans** were in reproductive growth stages R3 (pod formation) through R5 (full size pod ...
Cited by 335 Related articles All 22 versions Import into EndNote

Impact of reduced-risk **insecticides** on **soybean aphid** and associated natural enemies [PDF] iastate.edu
WJ Ohnesorg, KD Johnson... - Journal of economic ..., 2009 - academic.oup.com
Abstract Insect predators in North America suppress Aphis glycines Matsumura (Hemiptera: Aphididae) populations; however, **insecticides** are required when populations reach economically damaging levels. Currently, **insecticides** used to manage A. glycines are broad ...
Cited by 87 Related articles All 14 versions Import into EndNote

Resistance to the **soybean aphid** in **soybean** germplasm [PDF] usda.gov
CB Hill, Y Li, GL Hartman - Crop science, 2004 - dl.sciencesocieties.org
... 10, 11), 13 d (Exp. 14), and daily (Exp. 13) after transfer of **aphids**. ¶ MG, maturity group. †† VIPS = Variety Information Program for **Soybeans** ... **Aphid** Culture. Three clones of **soybean aphids** were established from single first-instar nymphs isolated from different **aphid** collections ...
Cited by 240 Related articles All 12 versions Import into EndNote

Photosynthetic responses of **soybean** to **soybean aphid** (Homoptera: Aphididae) injury
TB Macedo, CS Bastos, LG Higley... - Journal of Economic ..., 2003 - academic.oup.com
... **Soybeans** Asgrow 0901 were planted on 23 June in 0.76-m row width at 60705 plants/ha in a Waukegan silt loam soil ... Pretreatment **aphid** counts averaged 250/plant ... However, in previous research, Haile et al. (1999b) observed no changes in **soybean** photosynthesis, stomatal ...
Cited by 163 Related articles All 6 versions Import into EndNote

Ecology and management of the **soybean aphid** in North America [PDF] semanticscholar.org
DW Ragsdale, DA Landis, J Brodeur... - Annual review of ..., 2011 - annualreviews.org
... In 2007, SBA found colonizing F. alnus in Indiana were placed on **soybean** plants containing either Rag1 or Rag2 and readily colonized Rag2 **soybeans** ... Several **aphid** species have overcome single-gene resistance in many crops (147); however, the existence of ...
Cited by 391 Related articles All 11 versions Import into EndNote

Determining the optimal timing of foliar **insecticide** applications for control of **soybean aphid** (Hemiptera: Aphididae) on **soybean**

Preparation of experimental area: Target crop and arthropods impact trial design

- **Know your crop and environment**
  - Need for buffers or border rows if edge of trial different

- **Know your arthropods and environment**
  - Mobile arthropods require larger plots
  - Arthropods with clumped distributions may require larger plots or more replications

Sugarcane aphids infesting sorghum

Consider manipulating infestations

- **Natural infestations may not cooperate**
  - Too low, too high too quickly
  - Too early, too late…
  - In the fungicide trial across the road…

- **Increase target pest populations**
  - Decrease natural enemy levels

    Low rate of pyrethroids or OPs to kill beneficials and flare worms or aphids

    Ant bait to suppress fire ant populations to increase worm and stalk borer infestations

Consider manipulating infestations

- **Increase target pest populations**
  - Release fall armyworms in sweet corn

Consider manipulating infestations

- **Increase target pest populations**
  - Release wireworms in plastic tubs

Consider manipulating infestations

- **Increase target pest populations**
  - Increase N fertilization
    Mexican rice borer infestations increase with N fertilization
  - Increase plant stress (drought stress)
    Mexican rice borer infestations increase with drought stress

Manage infestations of non-target arthropods

- **Use selective insecticides/miticides if possible**
  - Lepidopteran worms can be controlled in stink bug or aphid trials
  - Aphids controlled can be controlled in lepidopteran worm trials
  - Some stink bugs may not be well controlled in lepidopteran worm trials

Knowledge of insecticides/miticides is key

IRAC MOAs

www.irac-online.org/modes-of-action/

https://www.irac-online.org/modes-of-action/

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Insecticide Resistance Action Committee

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The IRAC Mode of Action Classification

The definitive, global scheme on the target sites of acaricides and insecticides.

The IRAC Mode of Action (MoA) classification provides growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of acaricides or insecticides for use in an effective and sustainable acaricide or insecticide resistance management (IRM) strategy.

See the list of references describing established target site mutations.

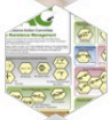
BROWSE THE CLASSIFICATION

Browse online now

The MoA Classification is available as an interactive searchable eTool allowing you to browse and filter chemical groups, classes and actives.

Get the classification to go

Download the IRAC MoA application from the Apple iTunes or Google Play App Stores for quick access to reference information on the move.



Print the MoA Structures Poster

The MoA poster with the chemical structures is available for download from the website in various languages including Chinese & Japanese!

> Download the Classification Scheme in PDF

The complete MoA Classification document is available to view or download. This 23-page document provides full details of the scheme with lots of supplimentary information and guidance.

KEEP UP TO DATE

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Subscribe to receive a notification when IRAC updates the Mode of Action Classification.

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Submit an active you think should be included in IRAC's Mode of Action Classification.

> View the MoA video

Our team of technical experts are charged with maintaining the classification and it's status.

> Meet the team and see more resources

Review all of our Mode of Action documentation.

THE IRAC MOA CLASSIFICATION

filter by mode of action, chemical class or active...

KEY

Class	MOA No.
Organophosphates Carbamates	1
Pyrethroids, Pyrethrins	3A
Nicotinoids, Sulfoximines, Butenolides	4A, C, D
Spinosyns	5
Avermectins	6
Fenoxycarb, Pyriproxifen	7
Pyridine azomethine derivatives	9
Bt	11
Benzoylureas	15
Buprofezin	16
Cyromazine	17
Diacylhydrazines	18
METI acaricides & insecticides	21
Tetronic & tetramic acid derivative	23
Diamides	28
Flonicamid	29

Treatment applications

- **Timing and threshold**
  - **At-planting**
  - **During the growing season**
    Based on periodical sampling and recommended or experimental thresholds

    Based to crop phenology and historical pest numbers

Treatment applications

- **Foliar applications**
  - Equipment: Backpack, small plot, self-propelled sprayer, commercial equipment
  - Volume of application, tip type and spacing, pressure, speed of application
  - Use of adjuvant
- **Soil applications**
  - In-furrow liquid or granular
  - Drench
- **Mimic commercial practices as much as possible**

Additional considerations for treatment applications

- **Contact vs. translaminar vs. systemic**
  - Do we have the information?
  - Should we change my application method?
  - Does it impact our sampling method?
- **Rainfastness**
  - Consider rain chances before applications
  - Consider chemicals tested
- **Safety and PPE**
  - If available: SDS or Label (signal word, REI)

Treatment evaluations: Pre-treatment vs. post-treatment

- **Overall experiment estimation**
  - Random samples throughout experimental area
  - Small number of samples for each plot

- **Individual plot estimation**
  - Same as post-treatment evaluation

Treatment evaluations: Sampling methods

- **Determine infestation levels**

  - Methods:

  Direct counts

  Sweep net sampling

  Beat sheet sampling

  Extraction

  - Variables: no. insects or mites / plant, sweep net sample, lens field

Treatment evaluations: Sampling methods

- **Determine infestation levels**
  - Provides reliable information on arthropod numbers, species composition, and size/stages

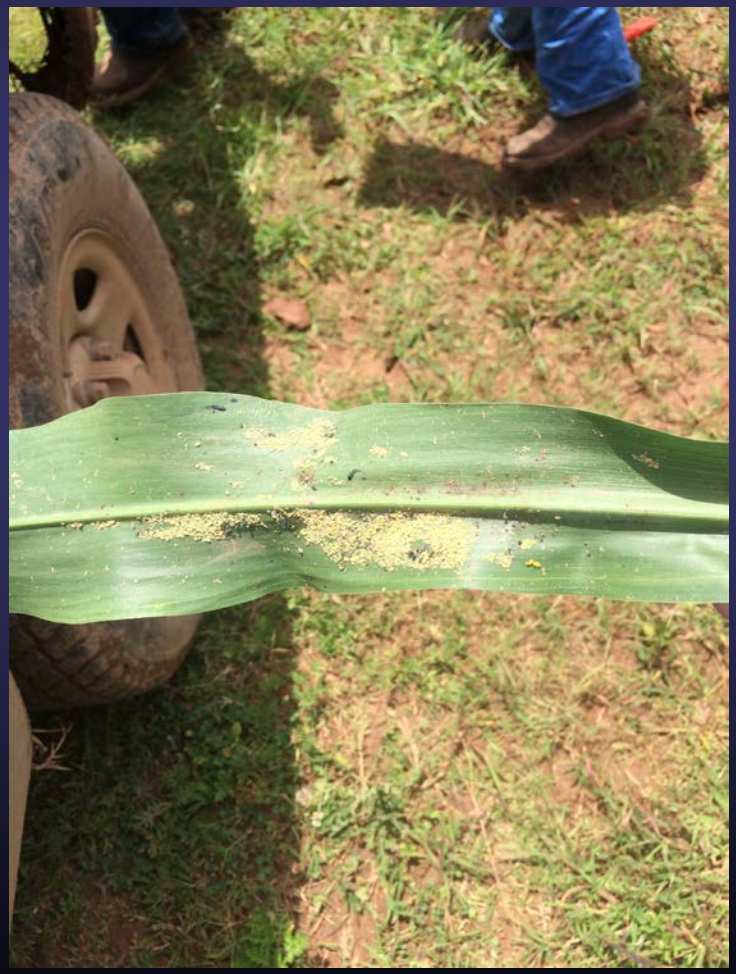
  - Can impact the integrity of the plots
  - Can be time consuming
  - Requires insect identification expertise
  - Can be biased relative to the people who collect data

Treatment evaluations: Sampling methods

- **Infestation levels**
  - No. banded cucumber beetles / sweep

Treatment evaluations: Sampling methods

- **Infestation levels**
  - No. sugarcane aphids / leaf



Treatment evaluations: Sampling methods

- **Infestation levels**
  - No. green stink bugs / sweep
  - No. brown stink bugs / sweep

Phytophagous stink bugs

Photo: Marlin Rice

Treatment evaluations: Sampling methods

- **Infestation levels**
  - No. small, medium, large fall armyworms / plant

Treatment evaluations: Sampling methods

- **Extension publications or apps**
  Featured Creatures:
  http://entnemdept.ufl.edu/creatures/

- **Bugguide: https://bugguide.net**

- **Entomology books and field guides**

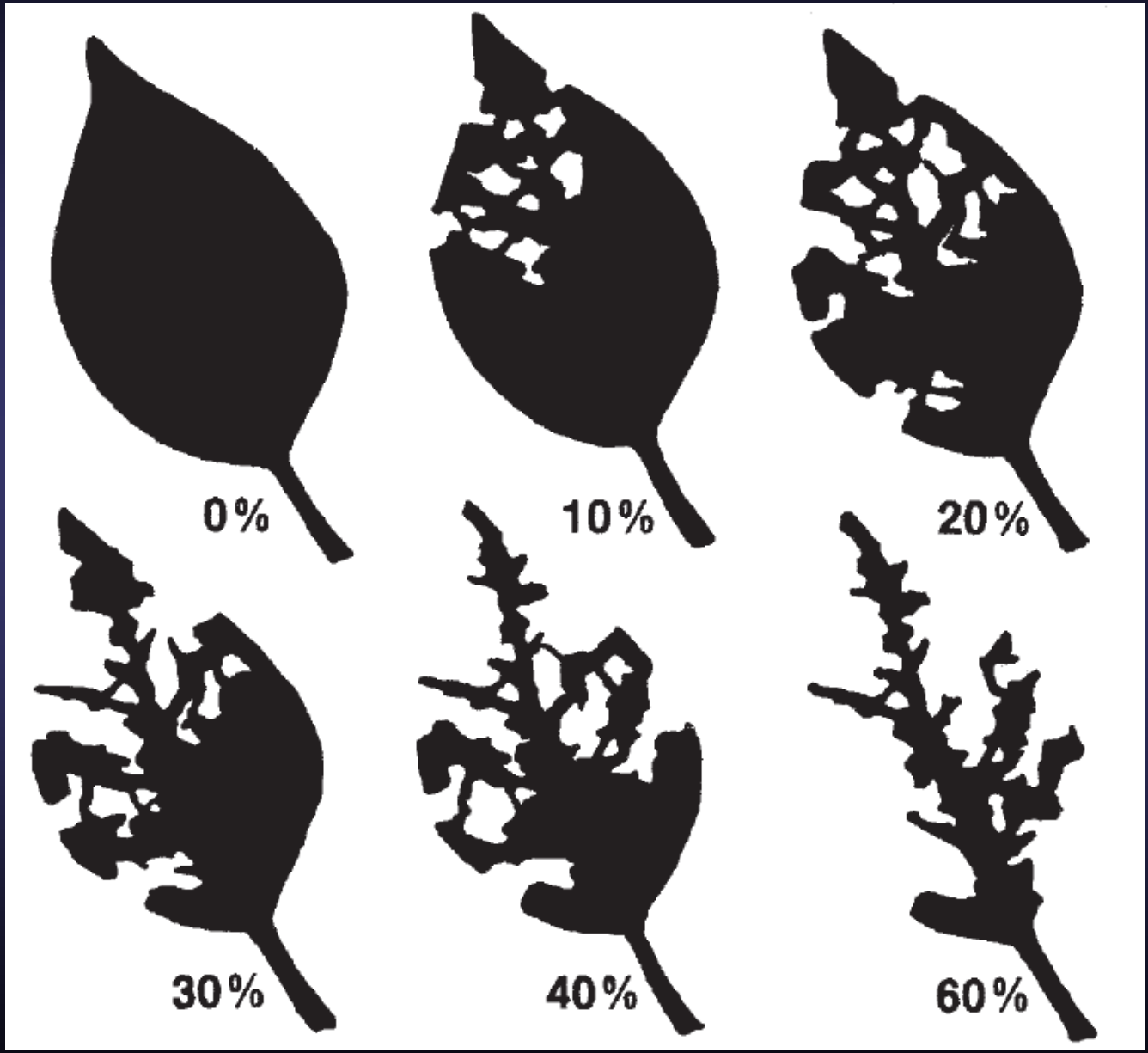
Treatment evaluations: Sampling methods

- **Injury** (inspection of fruits, seeds, leaves, stalks, roots)
  - Direct measurement vs. estimation or rating
  - Direct measurements are relatively unbiased but may not be practical
  - Ratings are quick and convenient but can be biased

  - Collecting injury ratings without infestation data can work, especially if we want to determine whether the product “works” or “doesn’t”

Sugarcane bored internodes

Defoliation estimation/ratings

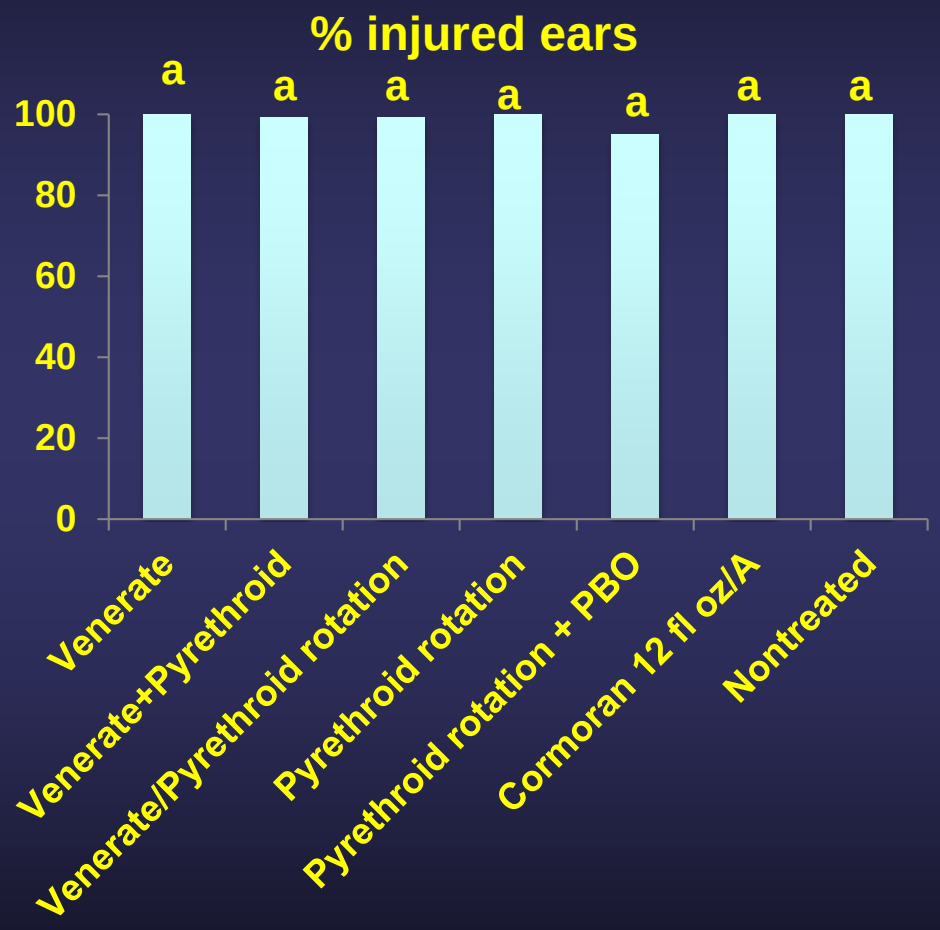


Corn silk flies

0 to 5 rating scale for ear injury

0: no injury
1: silks injured
2: ear tip injured
3: top 25% of ear injured
4: top 50% of ear injured
5: below top 50% of ear injured

Silk fly insecticide efficacy, 2018



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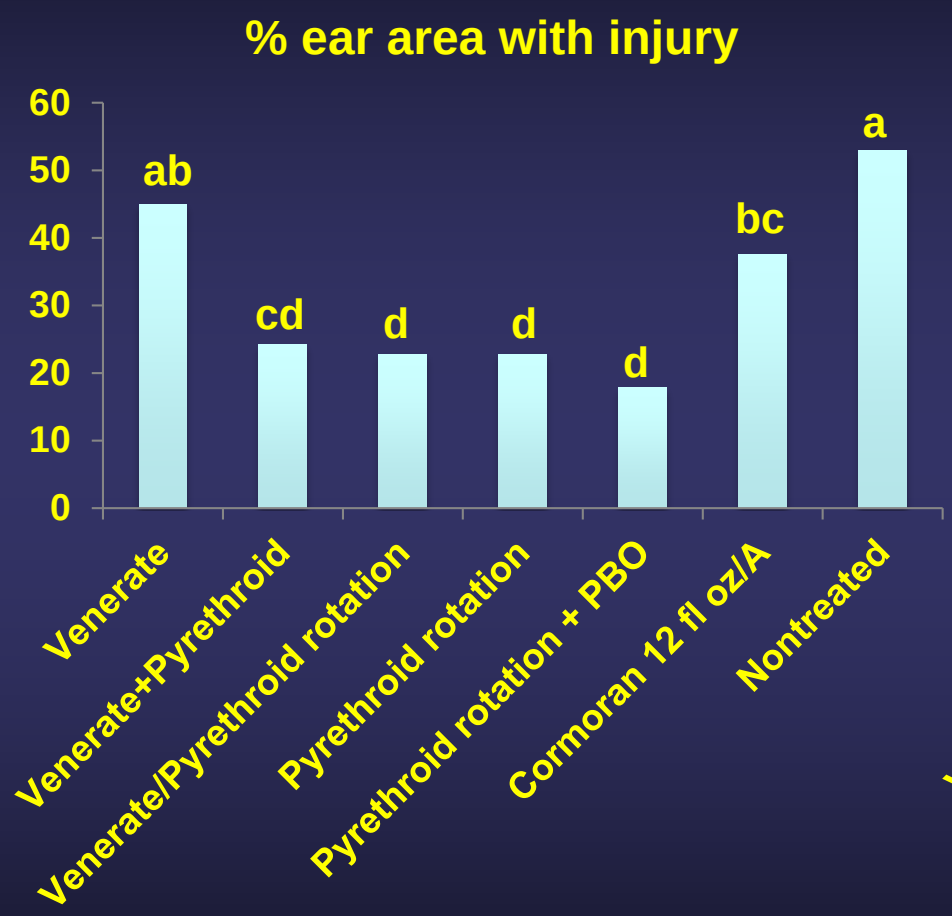
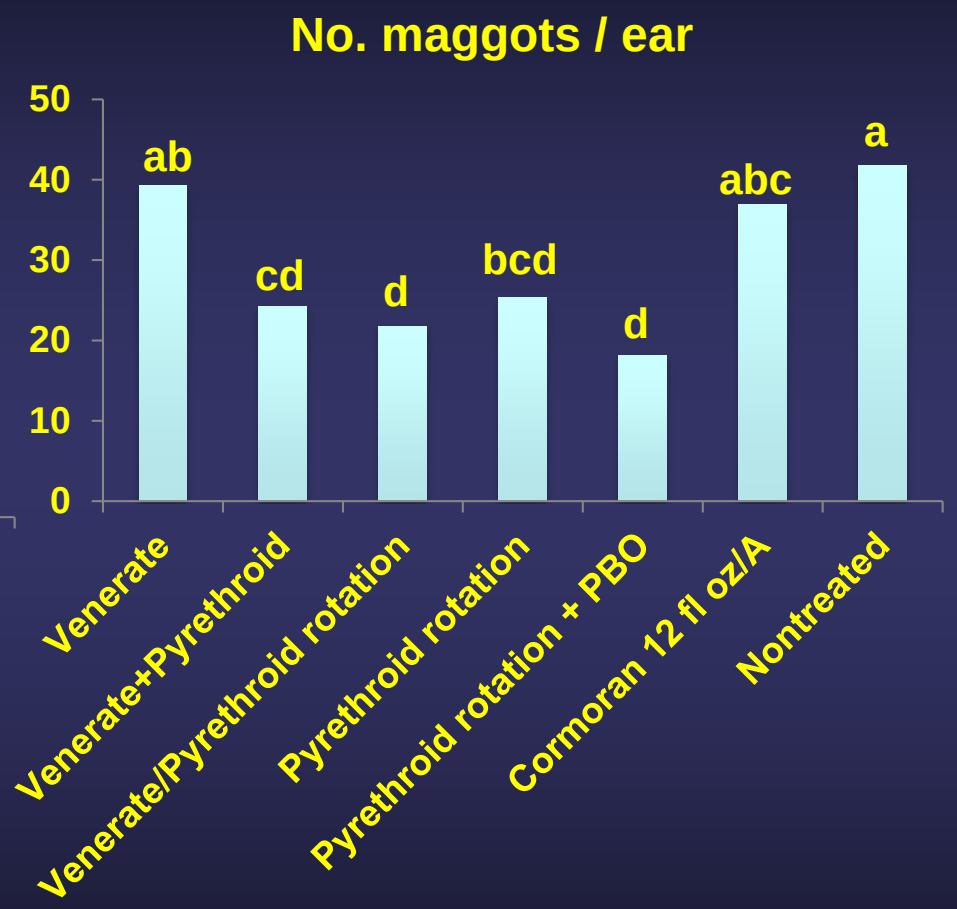
Silk fly insecticide efficacy, 2018





Bars with the same letter are not different (*P* > 0.05)

A Perspective on Insecticide Efficacy Research

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