Biological Control & Ideas for Insects

Erfan Vafaie
Extension Program Specialist, IPM
Email: erfan.vafaie@ag.tamu.edu
Office: 903-831-6191
Website: sixleggedaggie.com

Texas A&M AgriLife Extension

Integrated Pest Management

- Pre-1930's: insecticides created from mostly naturally occurring compounds (i.e. plants, inorganic compounds, petroleum)
- 1930's: synthesis of new compounds (i.e. DDT)
- Early 1950's and 60's: "The Green Revolution"
  - Agricultural production increased, but at a cost
  - Synthetic pesticides and fertilizers
- "Silent Spring" – Rachel Carson (1962)
- 1970's: USDA creates nationwide IPM program in Land Grant Universities

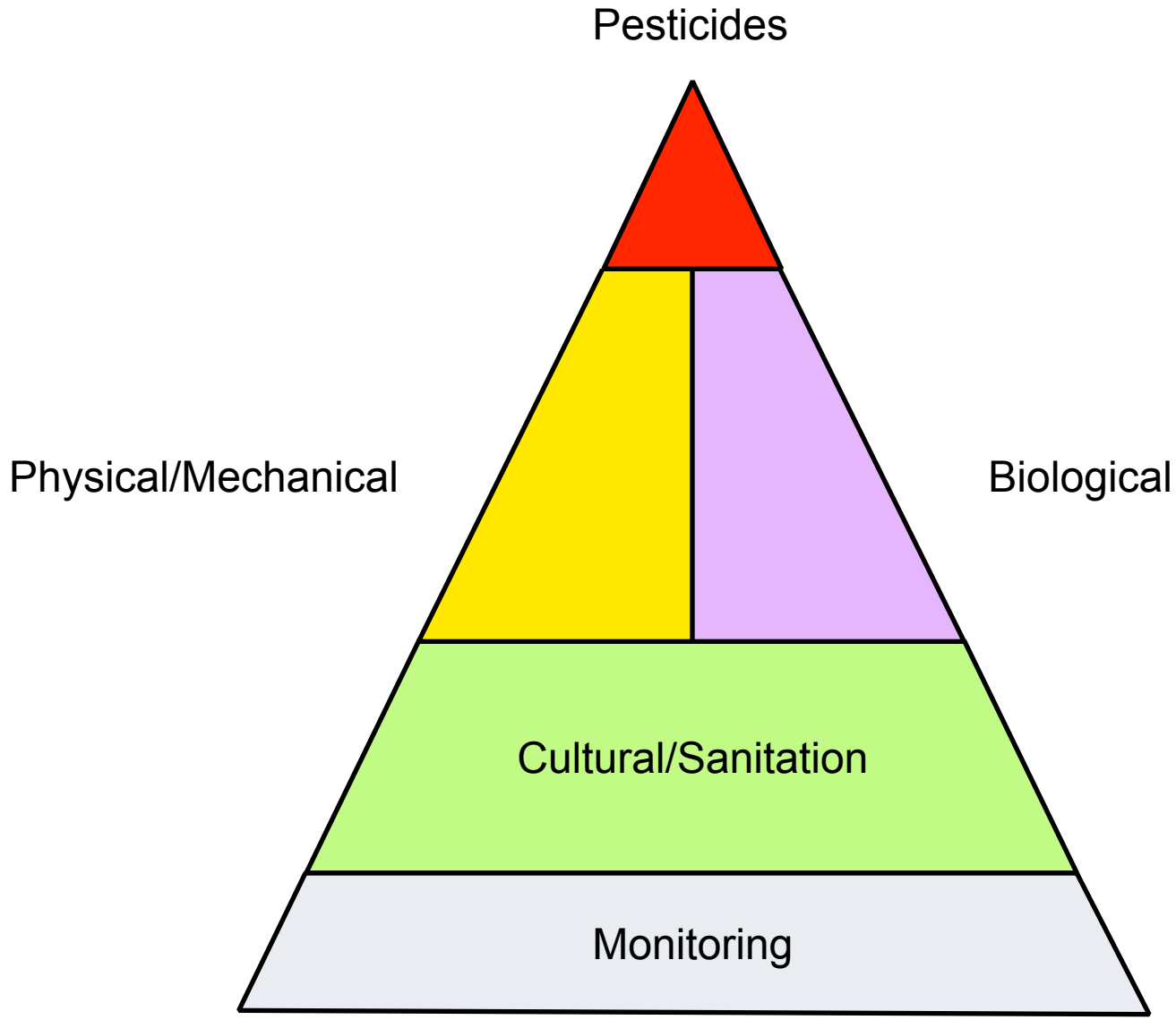
Integrated

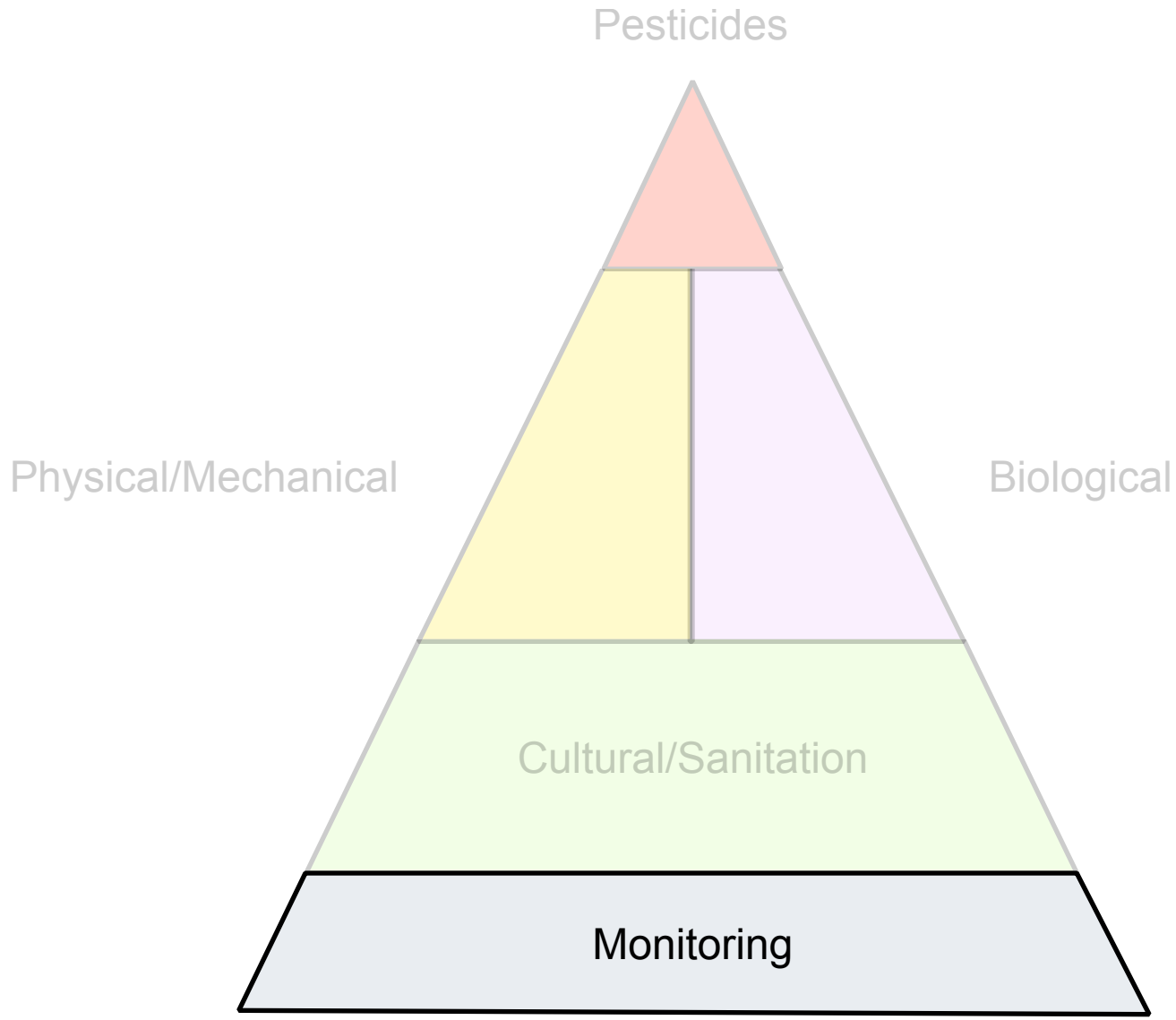
- Pre-193 m mostly naturally . plants, inorgani
- 1930's: s s (i.e. DDT)
- Early 19 evolution"

EXTENSION

Integrated Pest Management

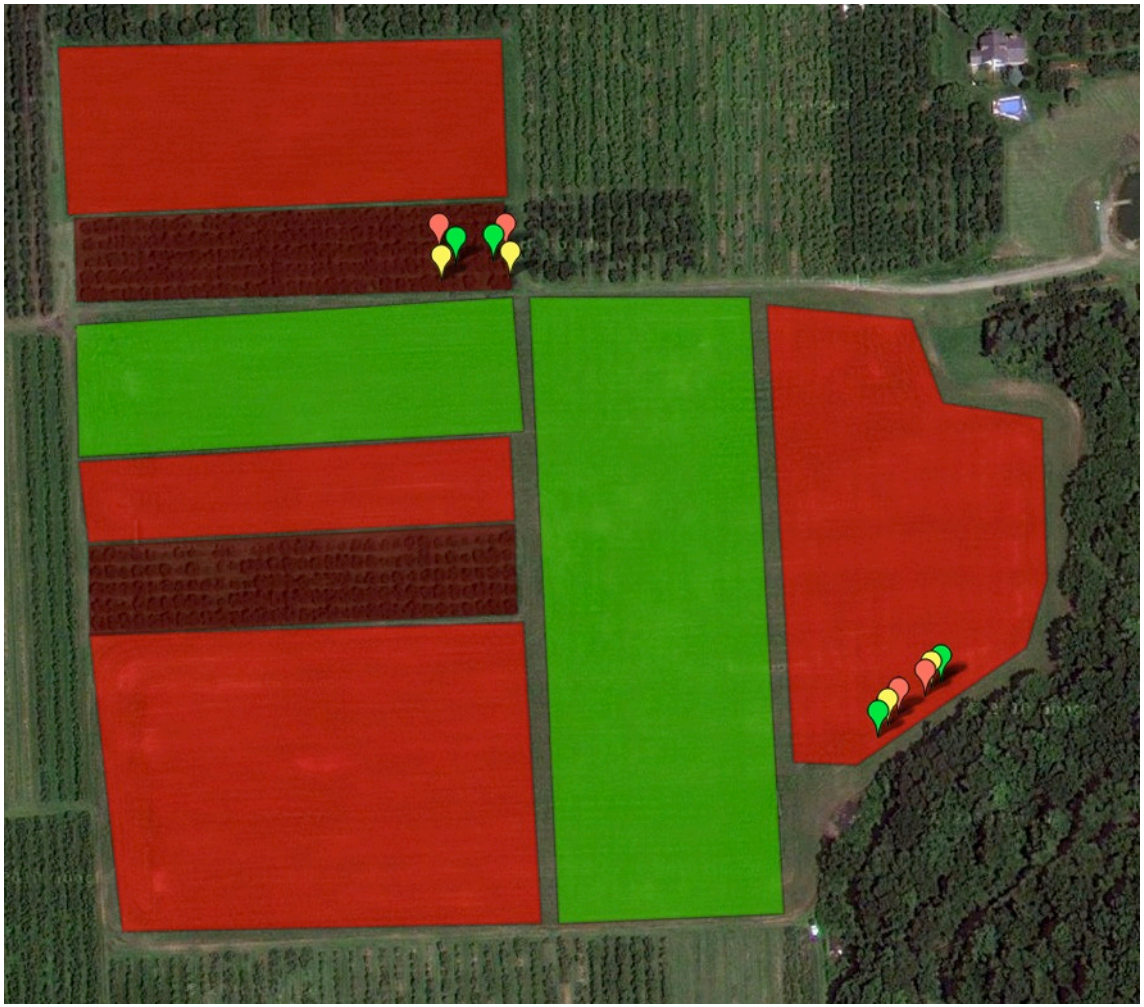
- Minimize impact on the environment
- Minimize impact on human health
- Maintain or increase soil fertility
- Long-term pest management
- Prevent pesticide-resistant pests
- Strives to maximize long-term returns/savings





Monitor

Pest Management Units



Texas A&M AgriLife Extension

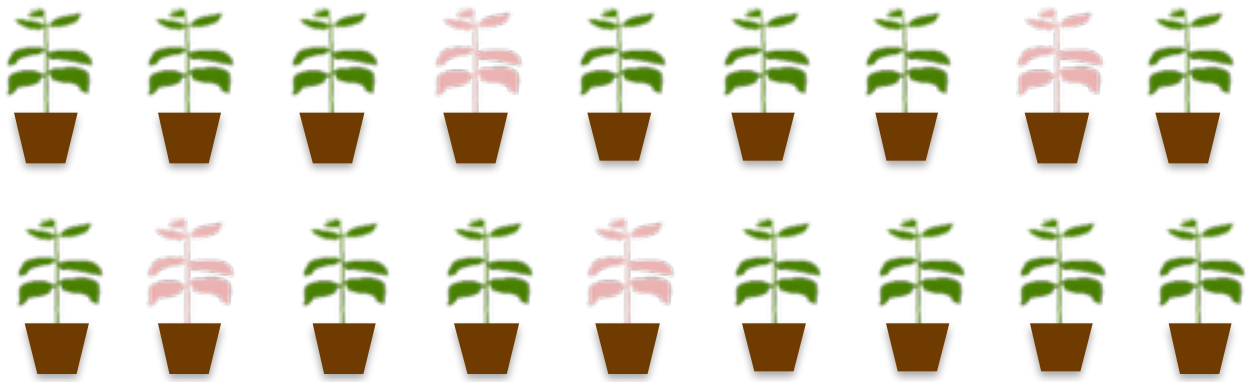
Monitor

Pest Management Units

Texas A&M AgriLife Extension

Monitor

Presence-absence sampling



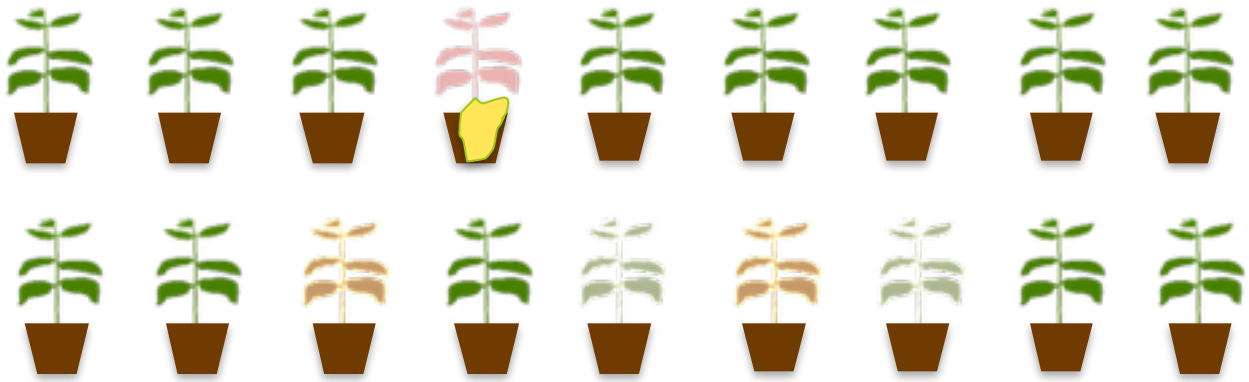
1/6 = 17%

4/20 = 20%

Texas A&M AgriLife Extension

Monitor

Indicator Plants



Higher infestation

Texas A&M AgriLife Extension

Monitor

Traps/Lures

Monitor

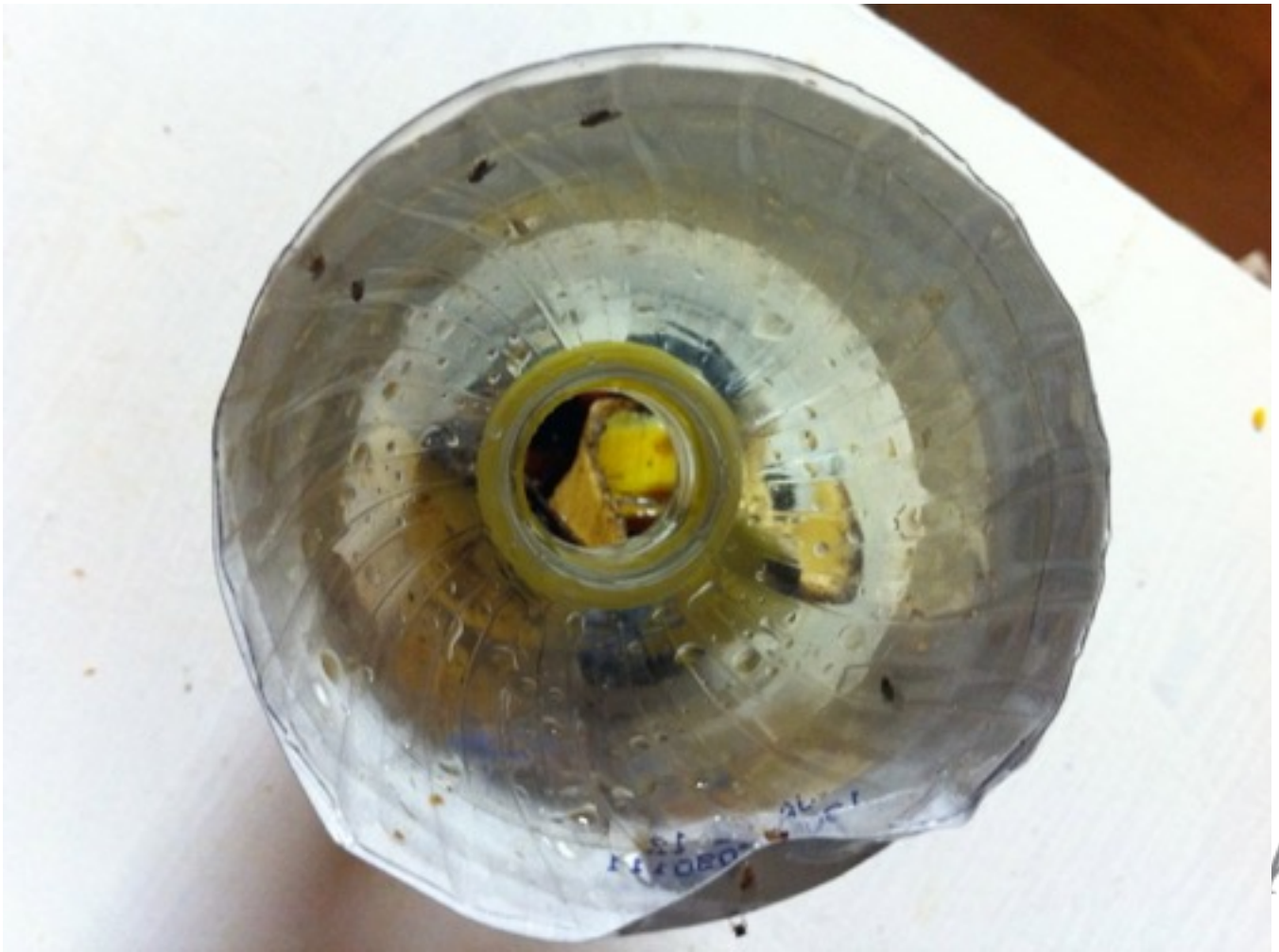
Traps/Lures

Photo Cred: Matron

TEXAS A&M AGRILIFE EXTENSION

Monitor

Traps/Lures



Texas A&M AgriLife Extension

Monitor

Larva

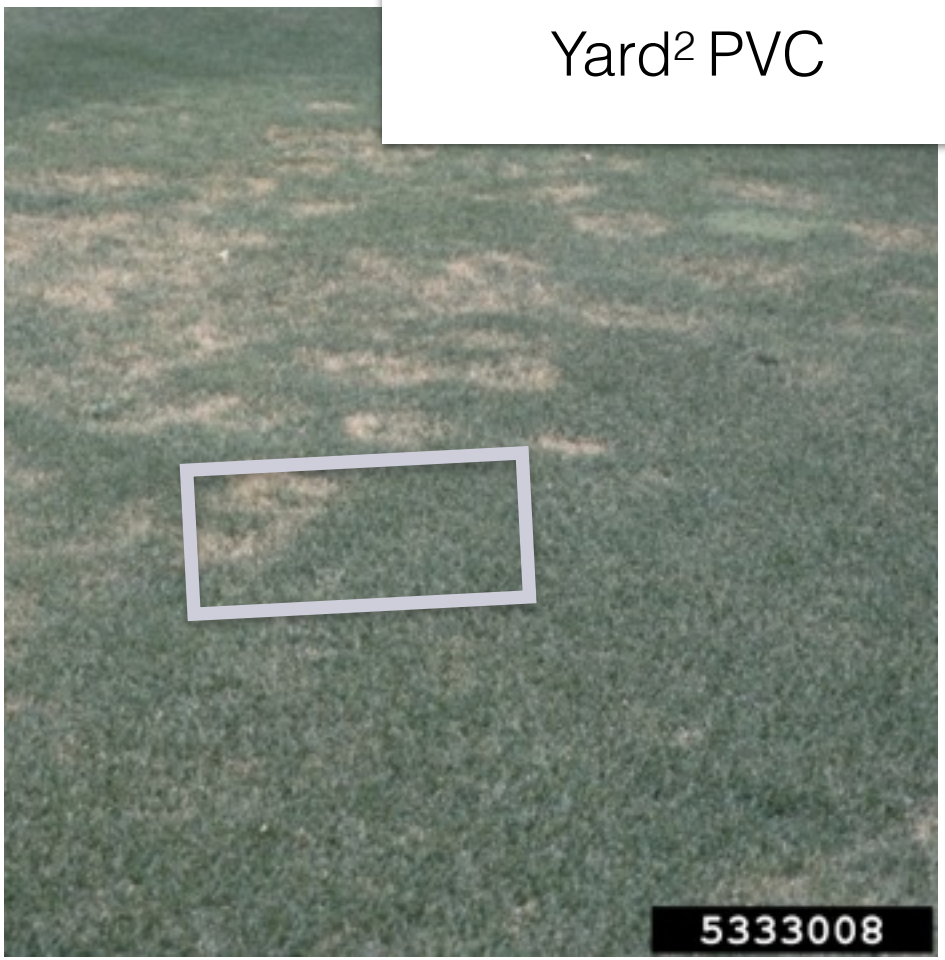
Photo: Kansas State University

TEXAS A&M AGRILIFE EXTENSION

Monitor

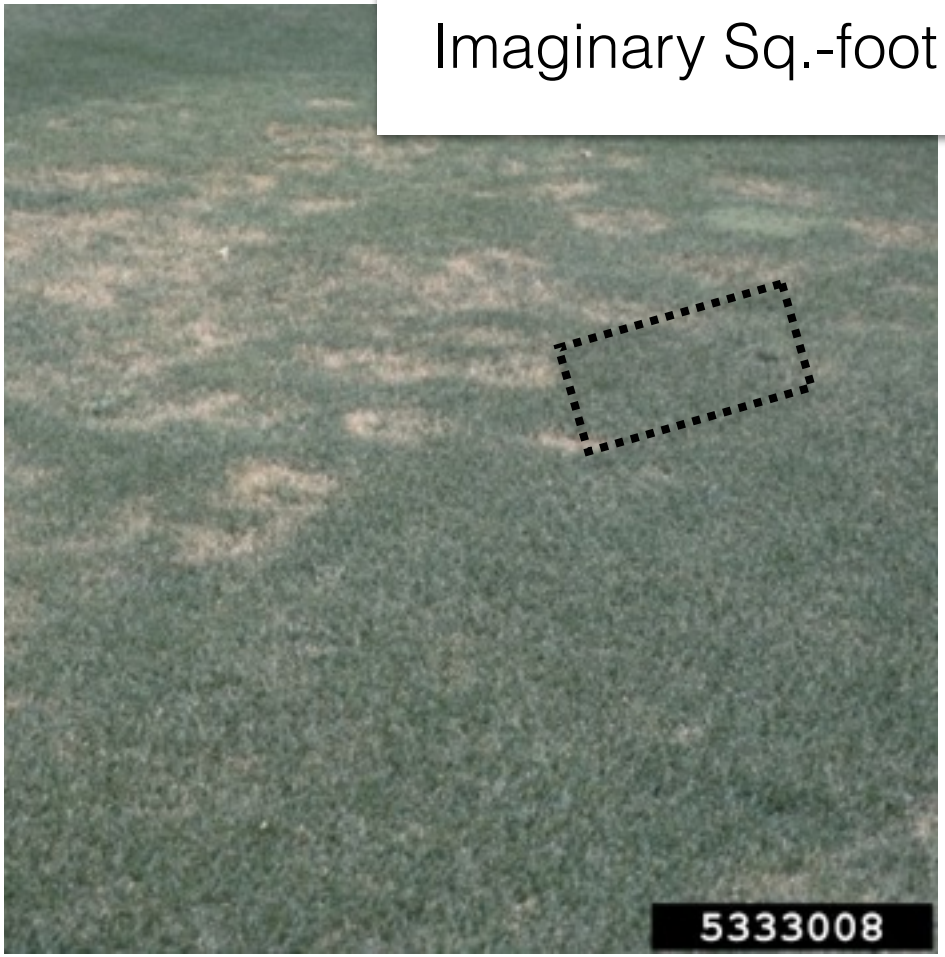
Larva

Yard^2 PVC



TEXAS A&M AGRILIFE EXTENSION

Monitor



Texas A&M AgriLife Extension

Monitor

Larva
Adults

Sweep nets

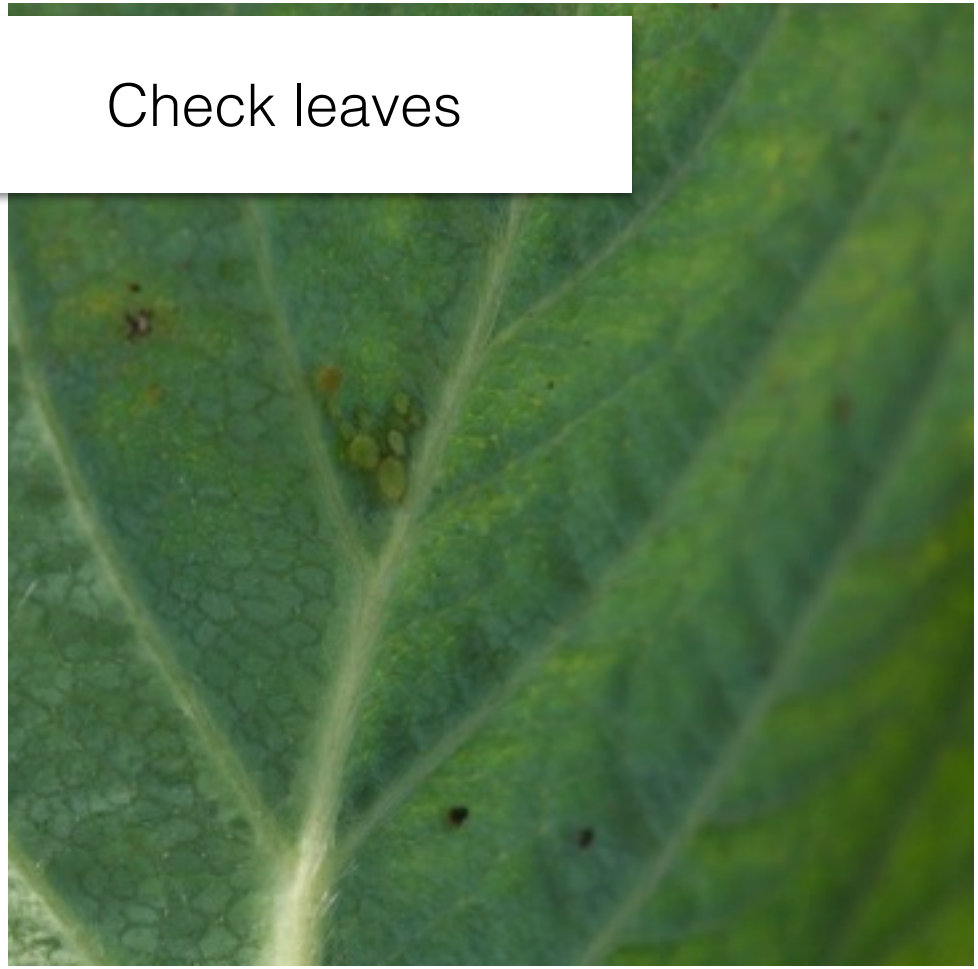
Figure 15. Proper use of a sweep net.

Photo: NC State University

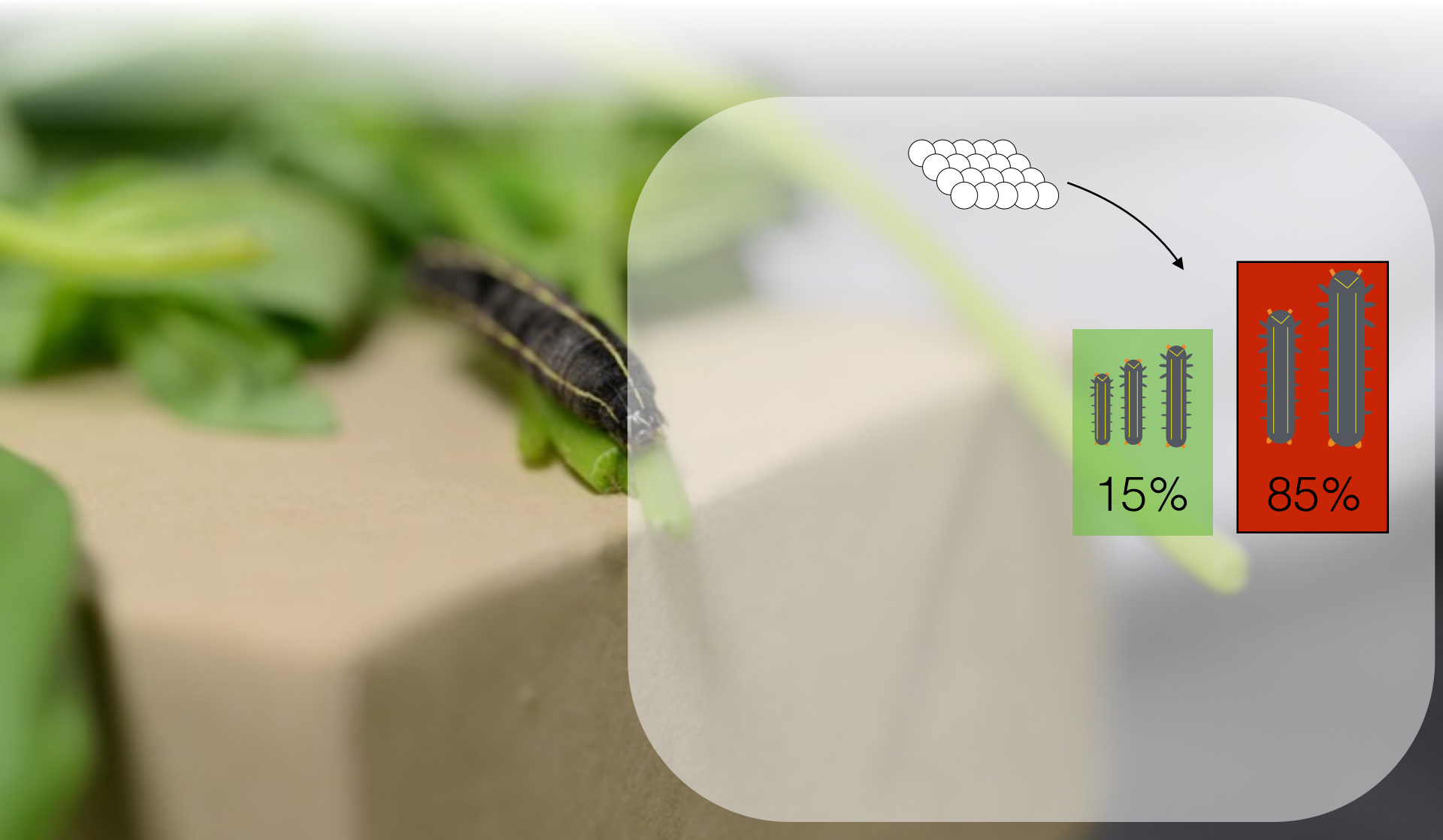
Monitor

Larva →

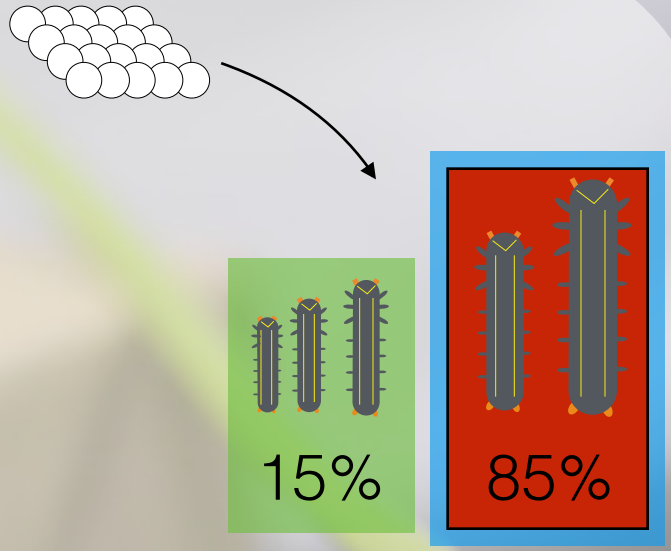
Check leaves



Armyworms

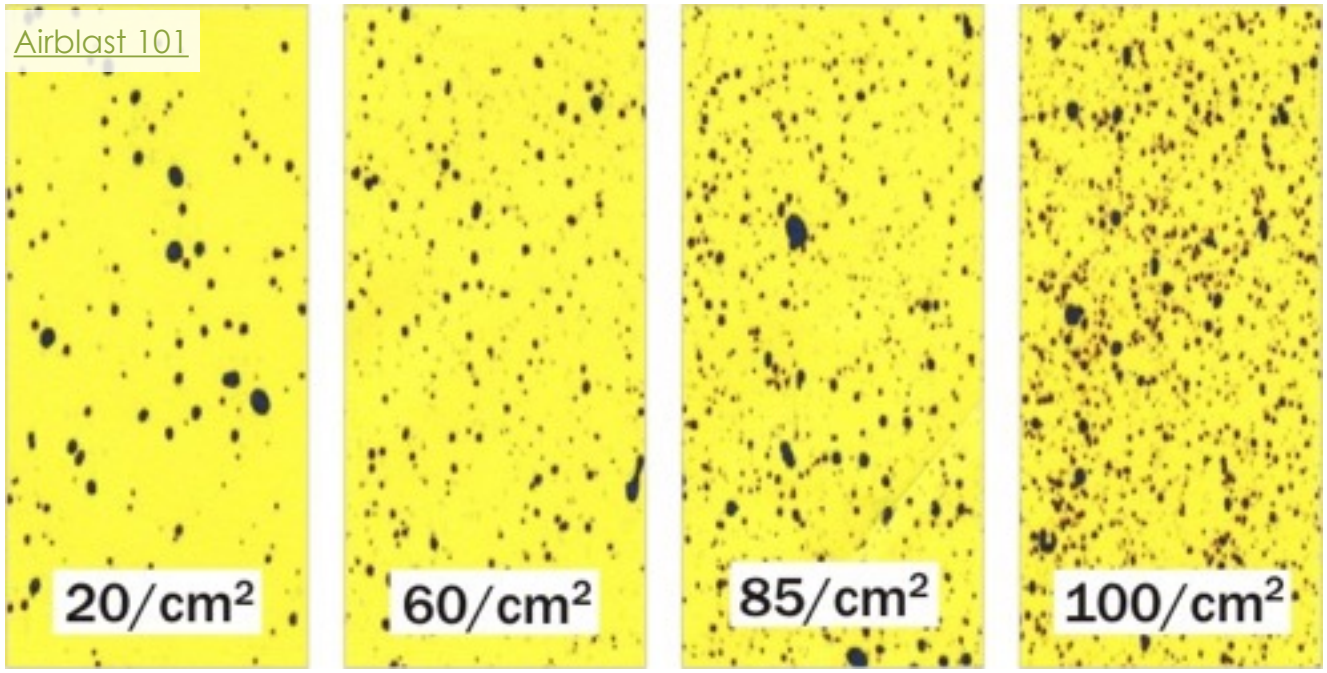



Dad, caterpillars are in the yard!!!
How many?
Tons…
ARMYWORMS!!!!


15%
85%

Monitor

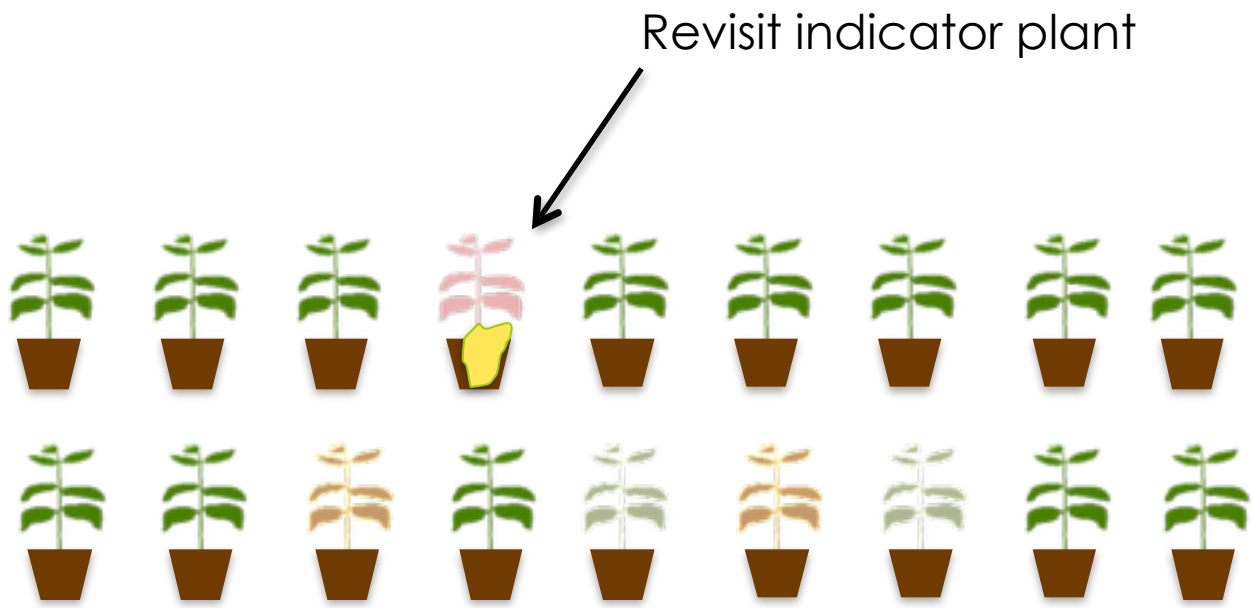
Control Efficacy



Texas A&M AgriLife Extension

Monitoring/Scouting

Control Efficacy



Monitoring Data Sheet

Mr. Awesome's Nursery

Awesome Monitoring Program

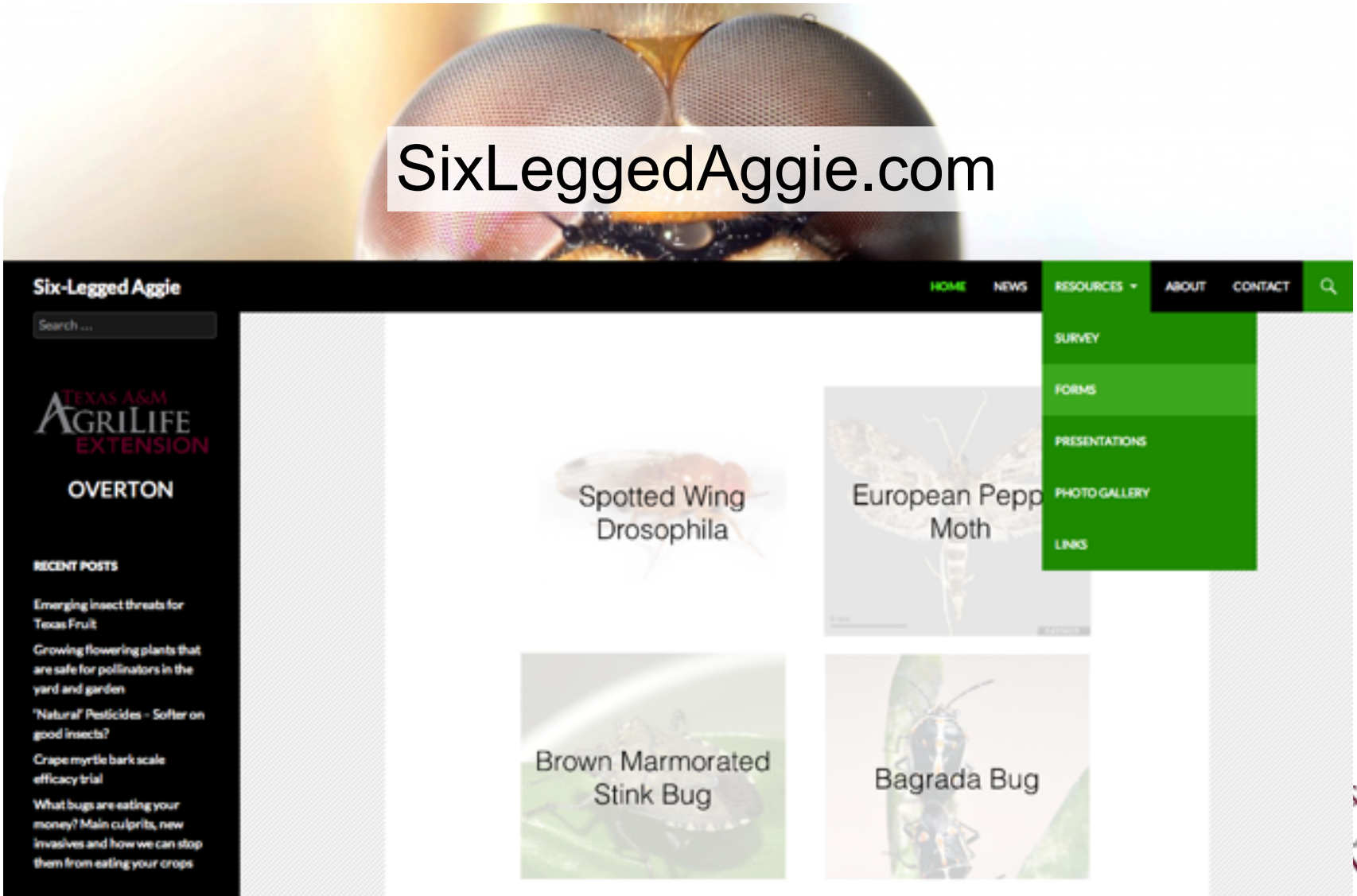
Date: 08/15/2014
Scout Name: Mr. Awesome Himself
Plot: Greenhouse 3

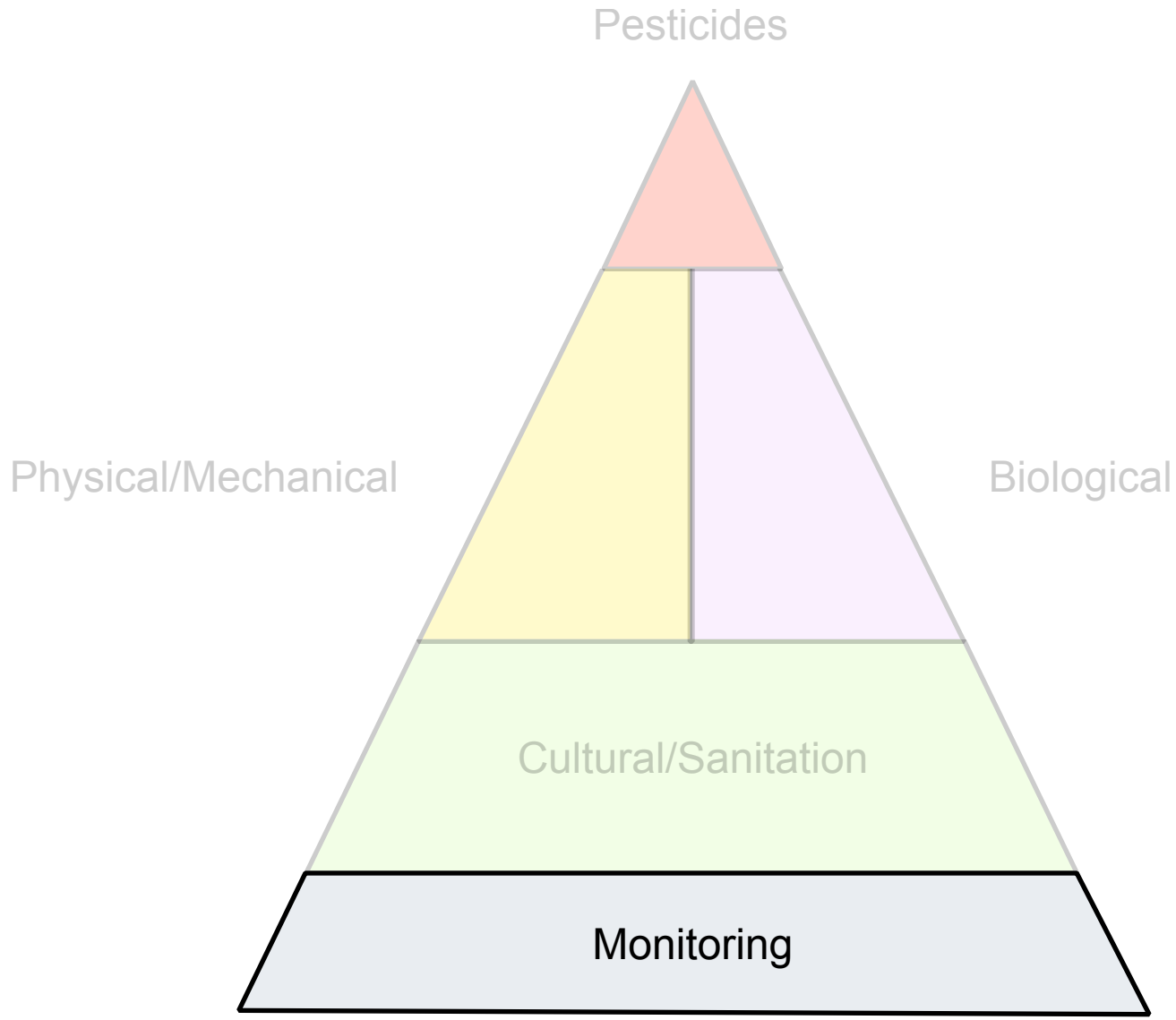
Crop: Zinnias
Crop Stage: Vegetative | Budding | Flowering | Post-Flowering
Sampling Method: Transect

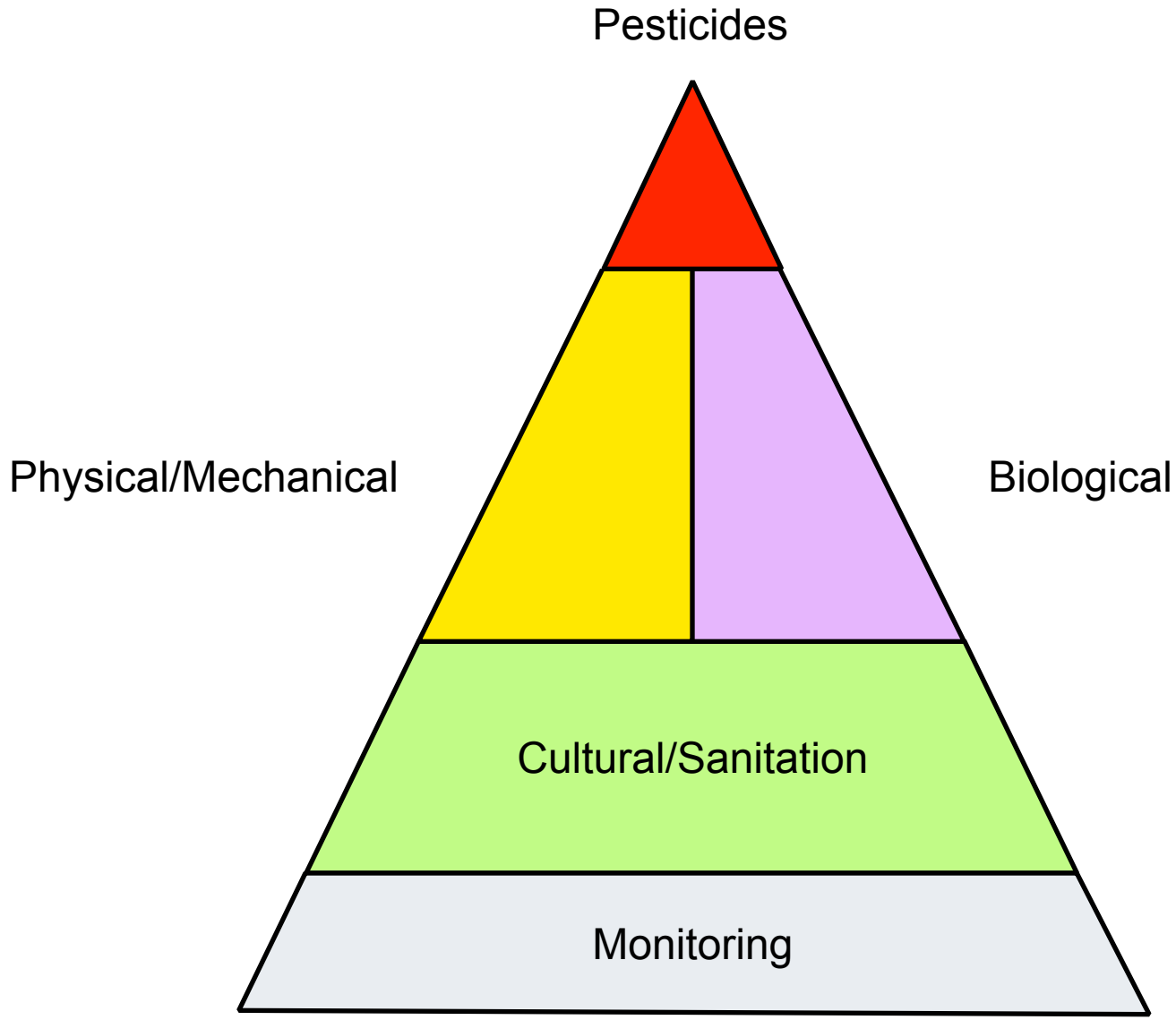
	Damage Rating (1 - 5)		Infestation Rating (1-5)				Beating (count)	
Sample	Rasping /Sucking	Defol	Aphid	Thrips	Armyworm	2SS Mite	Thrips	Notes:
1	1	1	1	2	1	2	4	Predatory mites?
2	1	1	1	1	1	1	2	
3	2	1	2	1	1	1	0	
4	1	2	1	1	1	1	0	
5								
6								
7								
8								
9								
10								
11								
12								

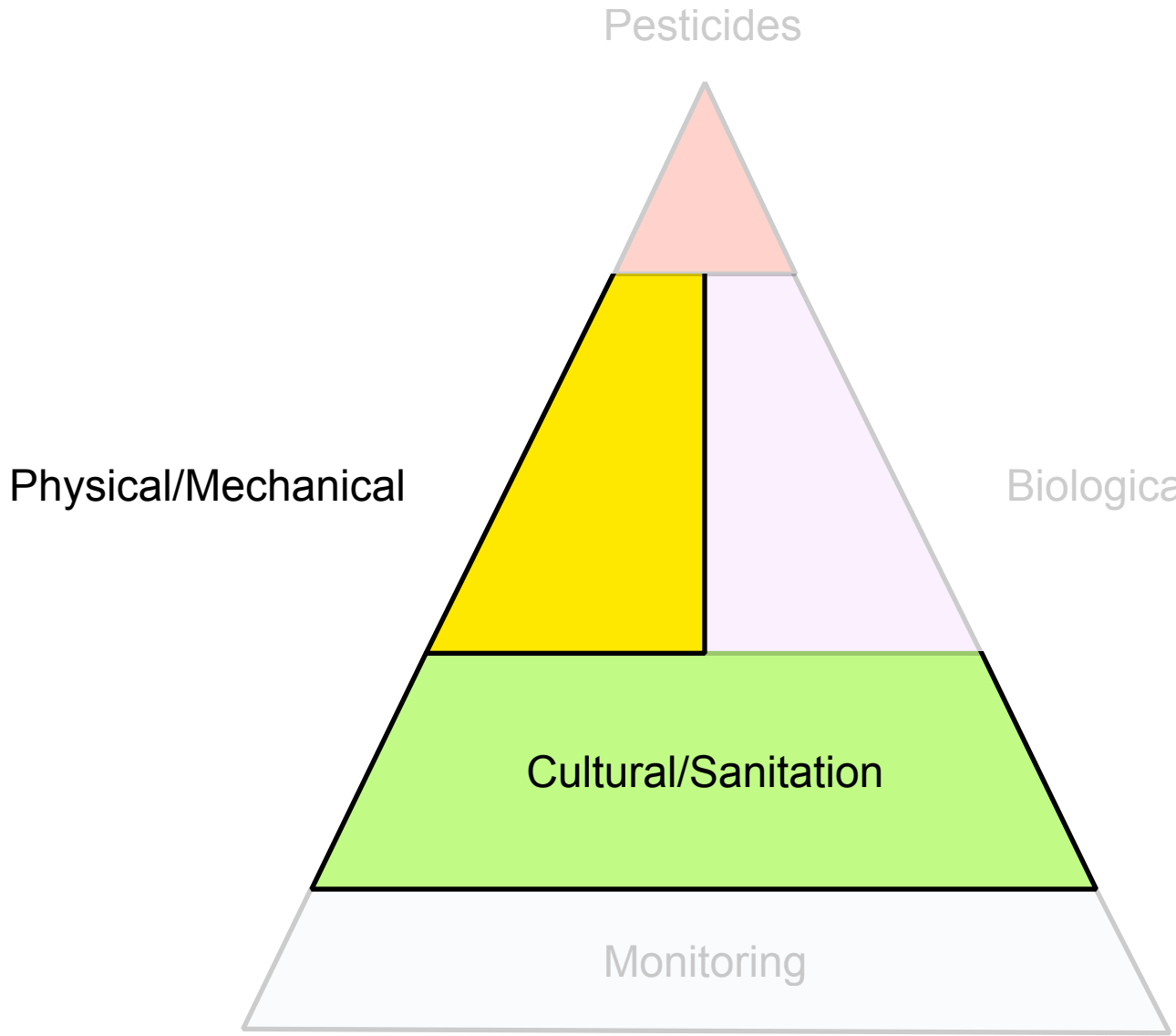
TEXAS A&M EXTENSION

Monitoring Data Sheet









Cultural/Mechanical

Sanitation

Cultural/Mechanical

Companion planting

Efficacy of three natural substances against apple aphid (*Aphis pomi* De Geer, Ap

Effect o

patula n

coloniza

Beata Janko

[1] Department c

Kraków, Pola

[2] Department c

29 Listopada

39%±12% (ci

the substances tested was found at highest concentration.

Marigold (*Tagetes erecta* L.) as an attractive crop to natural enemies in onion fields

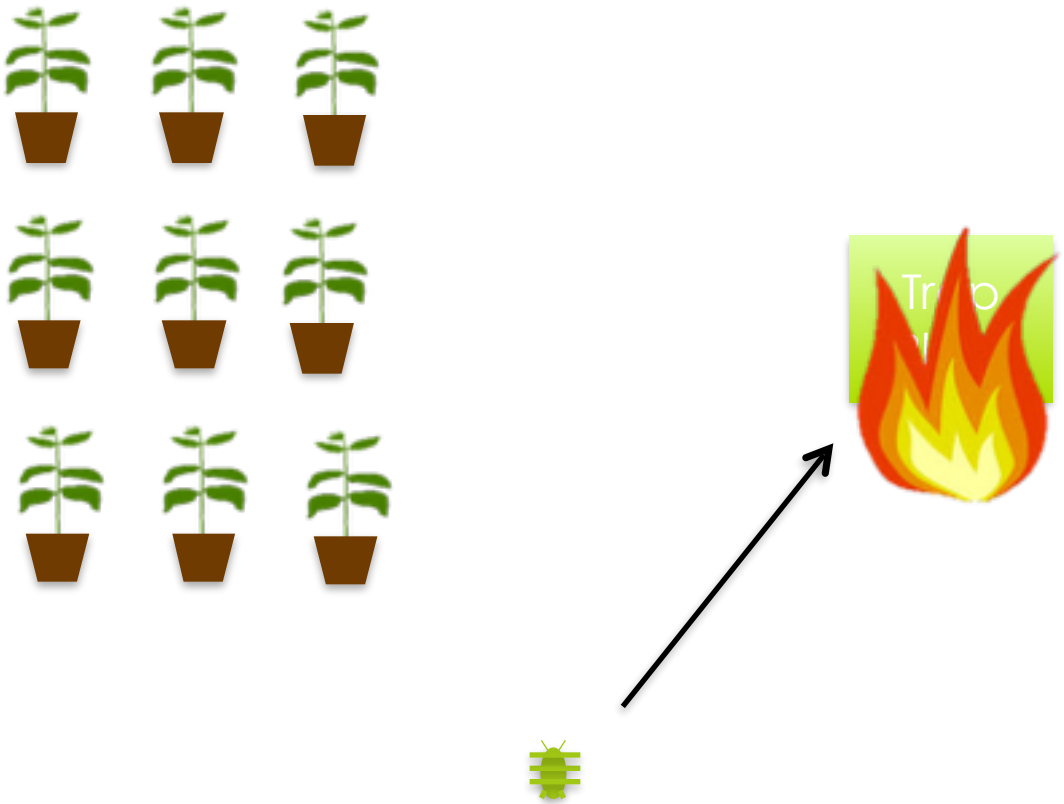
Cravo-de-defunto (*Tagetes erecta* L.) como cultura atrativa para inimigos naturais em cultivo de cebola

Luís Cláudio Paterno Silveira[I]; Evoneo Berti Filho[II, *]; Leonardo Santa Rosa Pierre[II]; Fernanda Salles Cunha Peres[III]; Julio Neil Cassa Louzada[IV]

EXTENSION

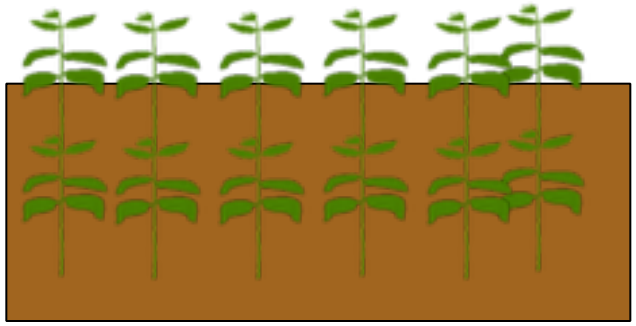
Cultural/Mechanical

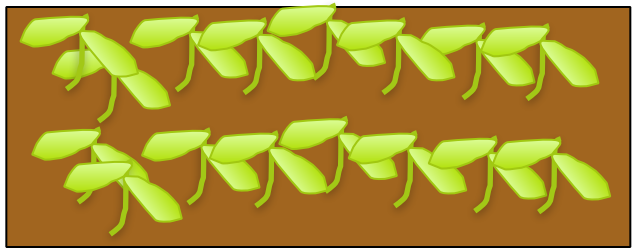
Trap Plants



Cultural/Mechanical

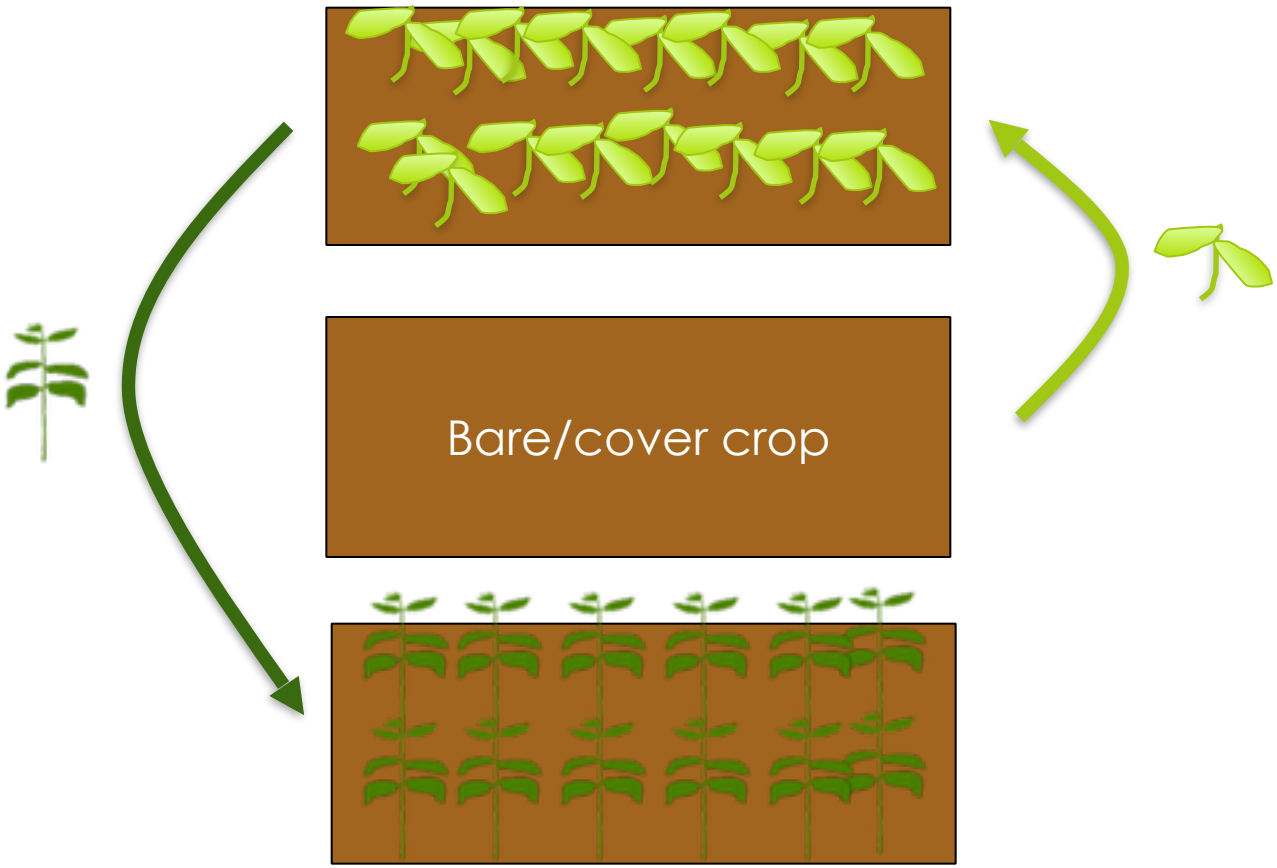
Crop rotation





Cultural/Mechanical

Crop rotation



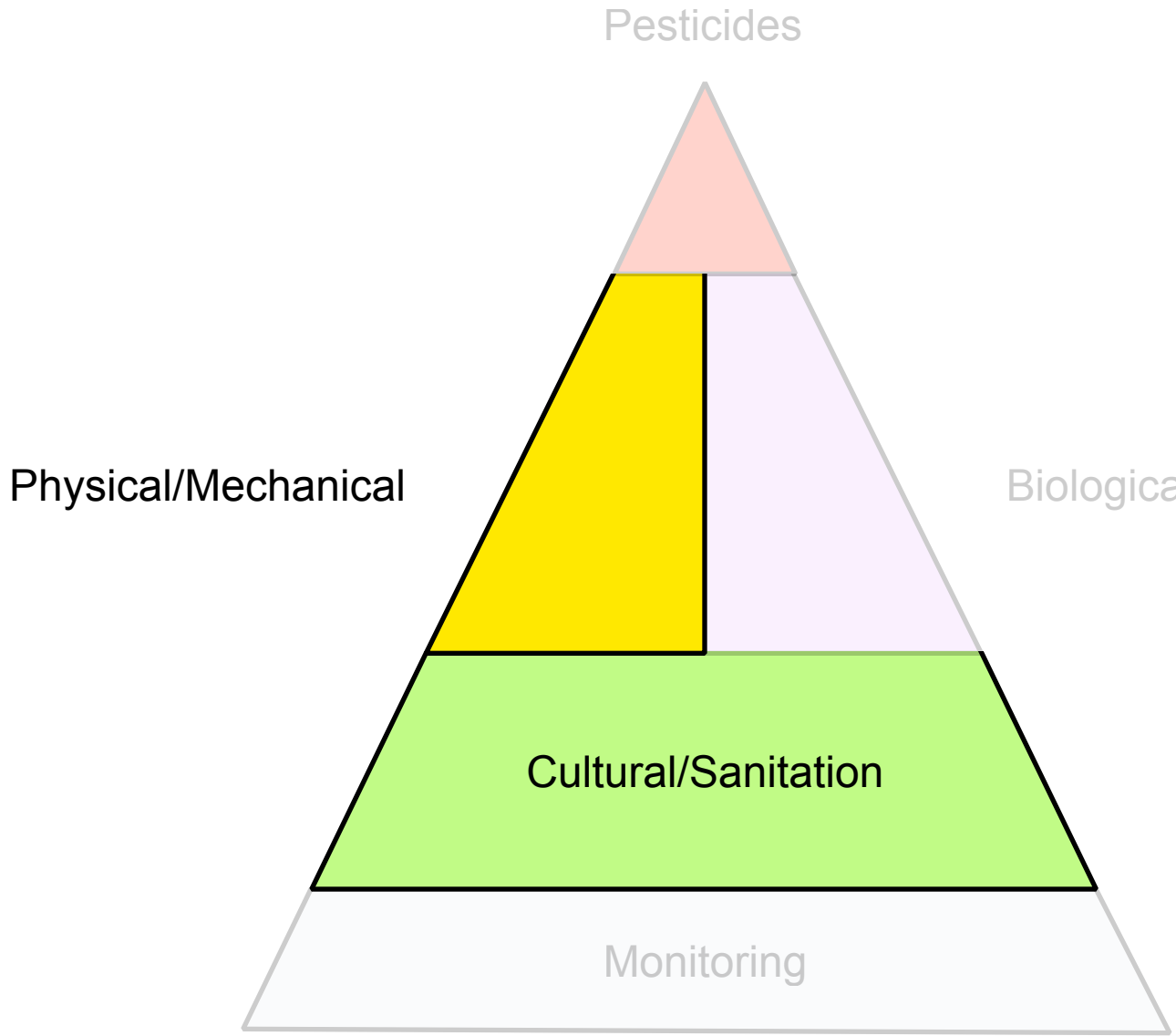
Cultural/Mechanical

Mechanical removal

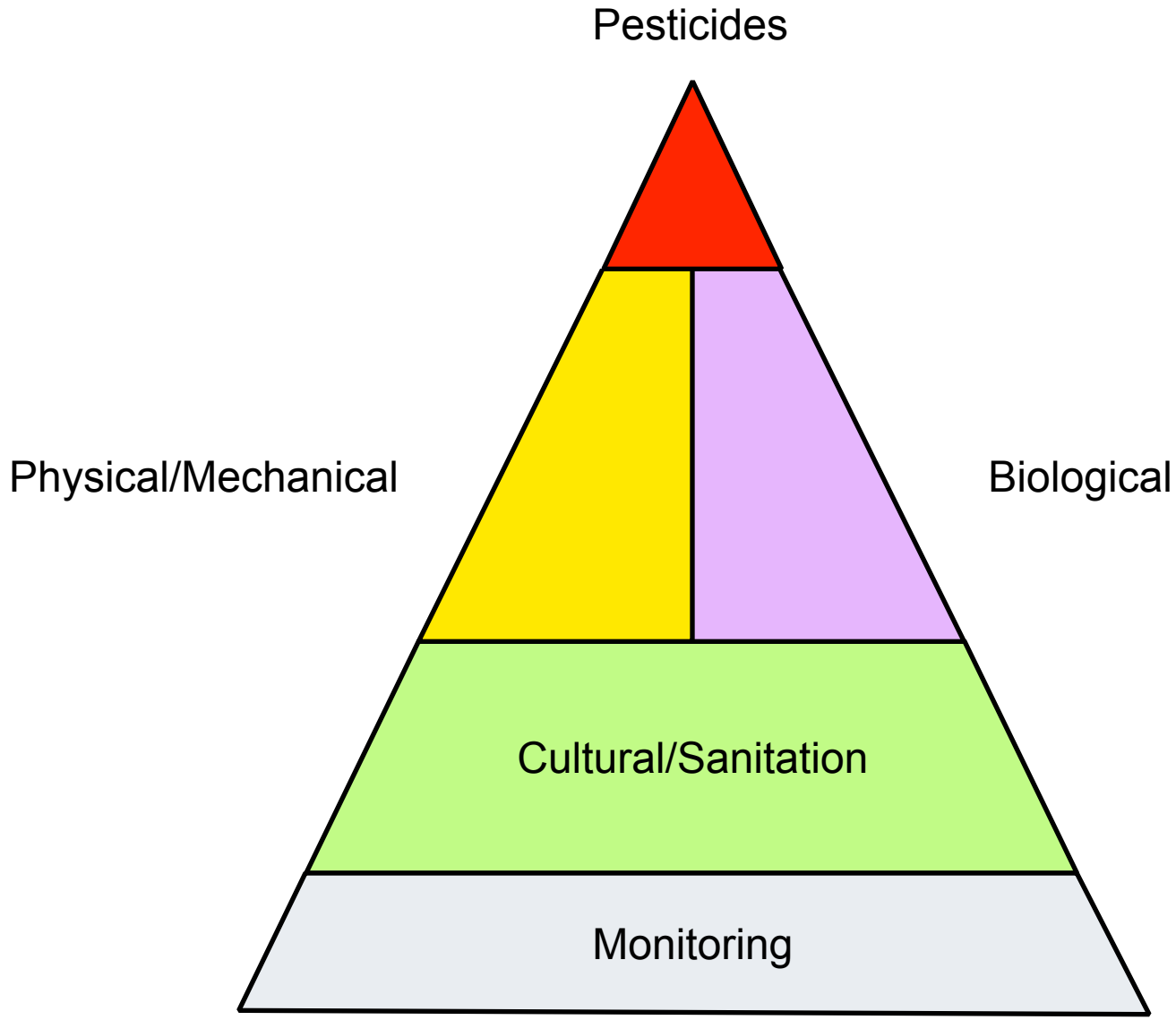
Cultural/Mechanical

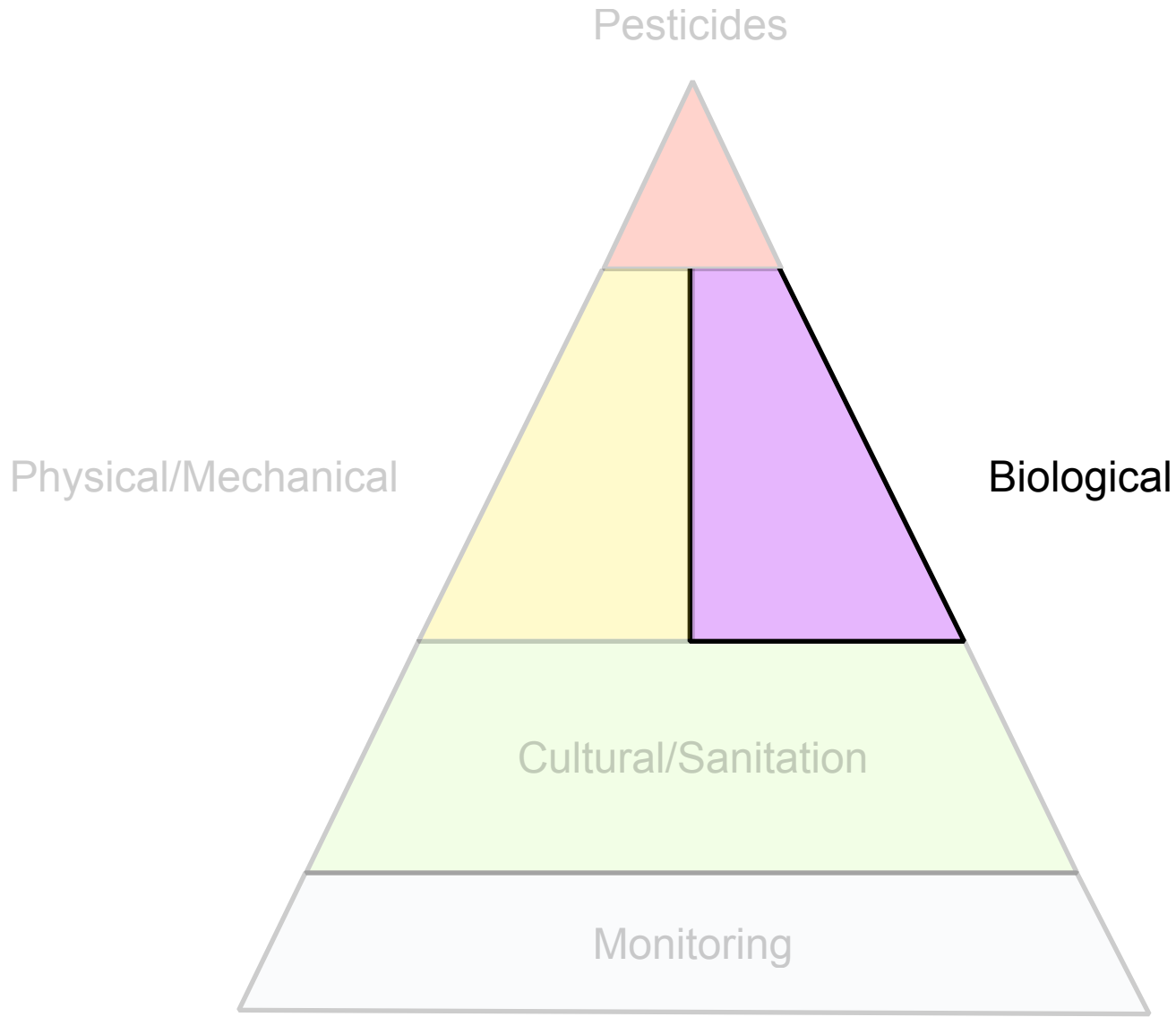
Exclusion

TEXAS A&M AGRILIFE EXTENSION



TEXAS A&M AGRILIFE EXTENSION





Biological Control

Biopesticides

US EPA - “naturally occurring substances that control pests (**biochemical pesticides**), microorganisms that control pests (**microbial pesticides**), and pesticidal substances produced by plants containing added genetic material (**plant-incorporated protectants**) or PIPs”

Biological Control

Biopesticides

US EPA - “naturally occurring substances that control pests (**biochemical pesticides**), microorganisms that control pests (**microbial pesticides**), and pesticidal substances produced by plants containing added genetic material (**plant-incorporated protectants**) or PIPs”

Biochemical pesticides | Horticultural Oils

Microbial pesticides | *Bacillus thuringiensis* (Bt) spray

Plant-incorporated protectants | Bt corn

Biological Control

Reduction of pests with the use of natural enemies

Good Bug → Kill → Bad Bug

Texas A&M AgriLife Extension

Why Biological Control?

Advantages

- Reproduce
- Target & find the pest
- Evolve with the pest
- Can be economic
- No environmental toxicity
- Don’t harm other beneficials
- No pesticide residue
- No phytotoxicity
- Insects are super cool!

TEXAS A&M AGRILIFE EXTENSION

Why Biological Control?

Disadvantages

- Not immediate
- Requires more human involvement
- Initially more costly; time to establish biocontrol program
- Must tolerate some damage
- Challenging in the face of new invasive pests
- Requires effective monitoring program
- Won't magically 'fix' pest problems

Texas A&M AgriLife Extension

Biological Control | Types

Sprays

Predators

Texas A&M AgriLife Extension

Biological Control | Sprays

- Bacteria, fungi, virus, or microparasites
- Easy application: use spray equipment
- Often short-term solution

Biological Control | Sprays

Predatory nematodes| *Heterorhabditis & Steinernema*

Photo: Scott Johnson

- Generalist: Asparagus beetle, Colorado Potato Beetle, Cucumber Beetle, Japanese Beetle, June Bugs, Oriental Beetle, Carrot Weevil, Citrus Weevil, European Chafer, Strawberry Root Weevil, etc.
- Applied using watering can, hose end sprayer, backpack or pump sprayer, or through irrigation system
- Results in 3-7 days

TEXAS A&M AGRILIFE EXTENSION

Biological Control | Sprays

Nosema locustae & Beauveria bassiana

Nosema

- Kills over 90 species of grasshoppers, locusts, and some species of crickets
- Infection can build throughout a season

TABLE 3

PERCENTAGE REDUCTION OF GRASSHOPPERS AFTER APPLICATION OF SPORES OF *Nosema locustae* (BASED ON NUMBERS OF GRASSHOPPERS ON CONTROL PLOTS WHICH WERE TREATED WITH BRAN CONTAINING NO SPORES)

Week after application	Percentage reduction in				
	All species	3 predominant species combined	3 predominant species separately[a]		
			M. infantilis	*M. sanguinipes*	*M. gladstoni*
4	21.6	33.5	0.0 (3.8)	3.0 (3.3)	58.3 (2.2)
5	13.1	23.0	0.0 (4.0)	0.0 (3.6)	70.3 (2.8)
6	27.5	34.5	17.1 (4.0)	12.0 (3.9)	56.7 (3.2)

[a] Average stage of development in parenthesis (see text).

Ewen & Mukerji (1980)

Biological Control | Sprays

Nosema locustae & Beauveria bassiana

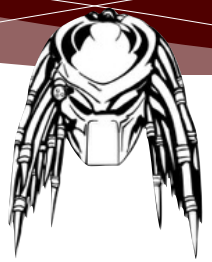
Nosema

- Kills over 90 species of grasshoppers, locusts, and some species of crickets
- Infection can build throughout a season

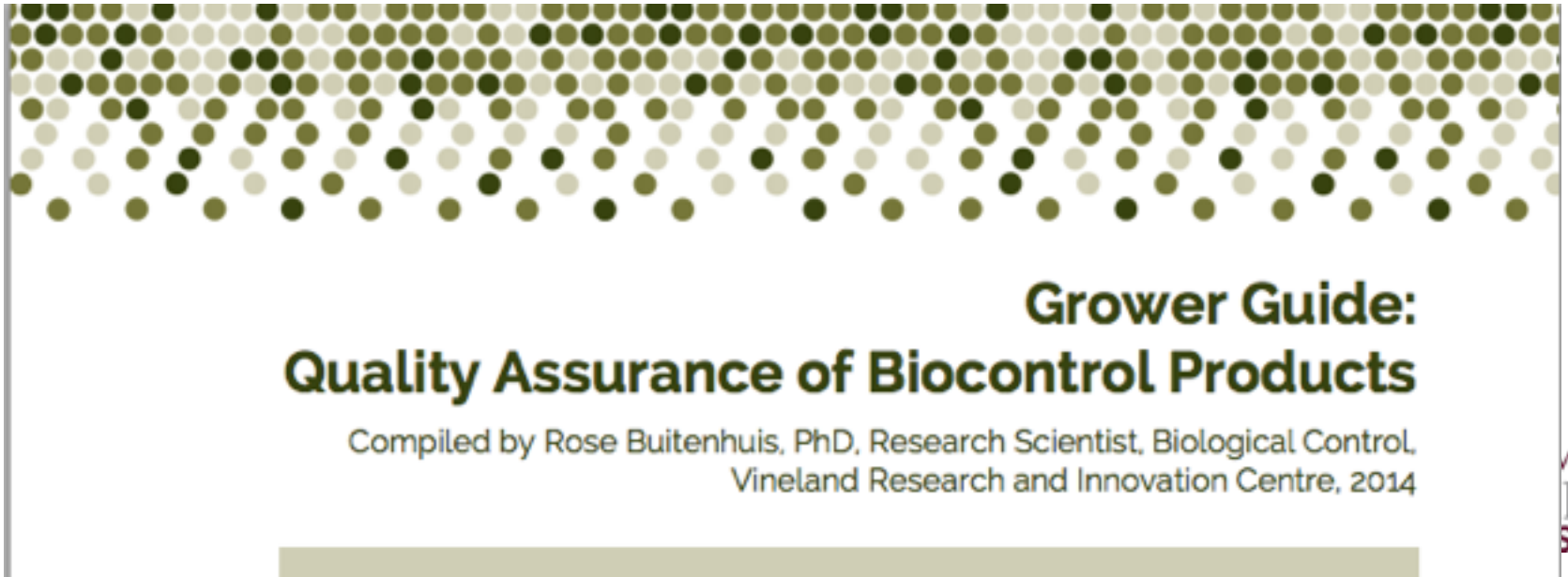
Beauveria

- Controls termites, thrips, whiteflies, aphids, and different beetles.
- Can provide >90% control with multiple applications (~every 4-5 days)
- Can incorporate in above-canopy irrigation

Biological Control | Predators



- Macroorganism
- Eat, lay eggs in, or decrease survival of pests
- Typically applied manually/by hand, in specialized release packets
- Quality control:



Grower Guide:
Quality Assurance of Biocontrol Products

Compiled by Rose Buitenhuis, PhD, Research Scientist, Biological Control,
Vineland Research and Innovation Centre, 2014

Video Credit: Franz Simon

Biological Control | Predators

Multicolored Asian Lady Beetle

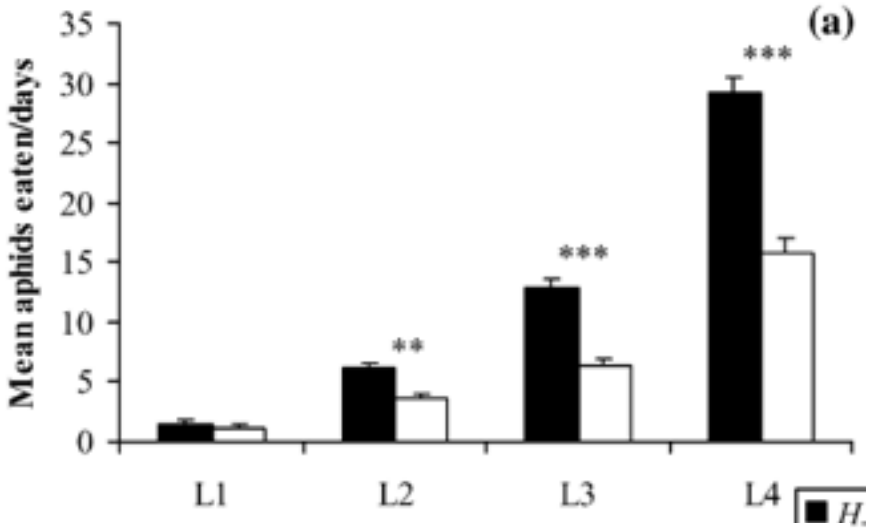
Biological Control | Predators

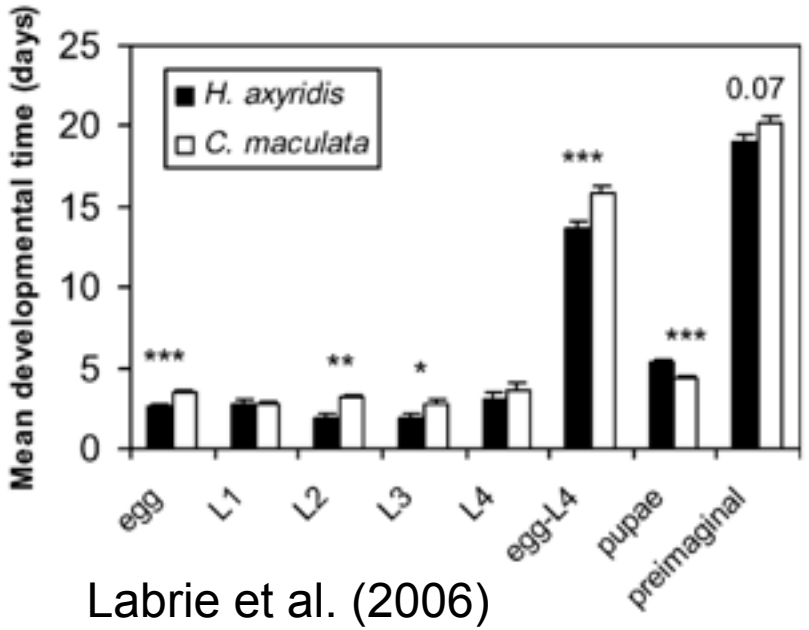
Multicolored Asian Lady Beetle

Texas A&M AgriLife Extension

Biological Control | Predators

Multicolored Asian Lady Beetle





Labrie et al. (2006)

Biological Control | Predators

Multicolored Asian Lady Beetle

Larva

185 aphids over 11 days

Variable	*M. persicae*	*A. fabae*
Diet		
Daily voracity (V_a)	45·8 ± 3·5a*	35·4 ± 3·3b
Daily relative consumption rate (*RCR*)	21·2 ± 1·6a	37·2 ± 3·4b
Relative growth rate (*RGR*)	3·9 ± 0·4a	4·1 ± 0·4a
Capture efficiency (*CE*)	0·082 ± 0·007a	0·125 ± 0·01b
Reproductive capacity		
Fecundity (Fc)	314·0 ± 42·6a	342·2 ± 32·9a
Fertility (Fr)	244·3 ± 41·3a	251·6 ± 29·1a
Percentage of hatching (Ph)	63·2 ± 7·5a	63·9 ± 7·0a

Soares et al. (2004)

TEXAS A&M AGRILIFE EXTENSION

Biological Control | Predators

Multicolored Asian Lady Beetle

Larva

185 aphids over 11 days

Adults

35 - 45 aphids/day
~240 viable offspring
Can live longer than a year

Generalist

Tend to disperse shortly after introduction

TEXAS A&M AGRILIFE EXTENSION

Video Credits: YouTube User encyrtid

Biological Control | Predators

Mealybug Destroyer

Biological Control | Predators

Mealybug Destroyer

- Native to Australia
  - Introduced to California in 1891 to control citrus mealybugs
- One larva can consume up to 250 young mealybugs[source?]
- Sensitive to cold
- Adult female lays her eggs in the cottony egg sack of the mealybug
- Adults & young larvae prefer eggs, older larvae eat mealybugs of all stages

Biological Control | Predators

Vedalia beetle

Biological Control | Predators

Vedalia beetle

- Introduced to California Citrus groves to control cottonycushion scale in 1889
- Established the practicality of biological control
- Had cleared some orchards (150 acres+) of the cottony cushion scale
- Only takes a few beetles to get a population started

- 8 - 12 generations per year
- Females lay ~150 - 190 eggs in their lifetime

Video Credits: YouTube User Pests and Natural Enemies

Biological Control | Predators

Green Lacewings

Biological Control | Predators

Green Lacewings

Biological Control | Predators

Green Lacewings

- AKA Aphidlion
- Consumes ~200 aphids/week
- Female lays up to 300 eggs over 3 - 4 weeks
- Generalist: insect eggs, aphids, thrips, mealybugs, immature whiteflies, and small caterpilliars.
- Released aphidlions can move 80 - 100 feet in search of prey.

Biological Control | Predators

Predatory Mites | *P. persimilis & A. andersoni*

Wyss U., Inst. Phytopathology, Kiel University, Germany

Texas A&M AgriLife Extension

Biological Control | Predators

Predatory Mites | *P. persimilis & A. andersoni*

Wyss U., Inst. Phytopathology, Kiel University, Germany

Biological Control | Predators

Predatory Mites | *P. persimilis & A. andersoni*

Wyss U., Inst. Phytopathology, Kiel University, Germany

Biological Control | Predators

Predatory Mites | *P. persimilis & A. andersoni*

Wyss U., Inst. Phytopathology, Kiel University, Germany

P. persimilis

- Feed on twospotted spider mite
- Average lifespan: 47 days
- Average offspring: 66 eggs
- Average max predation rate: 4.8/day

A. andersoni

- Feed on red and twospotted spider mite
- Average lifespan: 99 days
- Average offspring: 46 eggs
- Average predation rate: 7.2/day

Texas A&M AgriLife Extension

Biological Control | Predators

Minute pirate bugs | Orius

Texas A&M AgriLife Extension

Biological Control | Predators

Minute pirate bugs | Orius

- Feed on virtually any small soft-bodied insect: thrips, mites, aphids, whiteflies, leafhoppers, and many insect eggs.
- Adult lifespan: 3 - 4 weeks
- Consume numerous prey daily (~30 mites per day)
- Can feed on pollen when no prey available

Biological Control | Predators

Big-eyed bug

Biological Control | Predators

Big-eyed bug

- Lay 150 eggs/female
- Eat aphids, mites, insect eggs, small nymphs, caterpillars, and larvae
- Reportedly can eat as many as 1600 spider mites before reaching adulthood and 80 mites/day as adults
- Adults can survive on sunflower seeds and water (without insect food)
- Live ~30 days

Biological Control | Predators

Parasitic wasps

Texas A&M AgriLife Extension

Biological Control | Predators

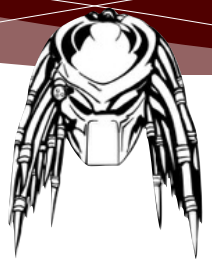
Parasitic wasps

Texas A&M AgriLife Extension

Biological Control | Predators

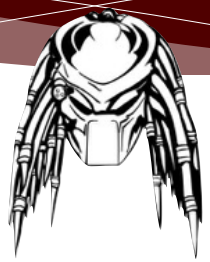
Parasitic wasps

Biological Control | Predators

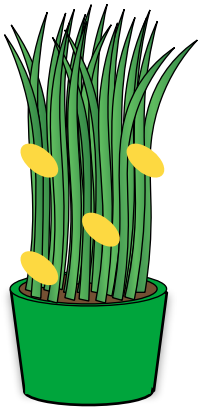


Banker plants

Biological Control | Predators

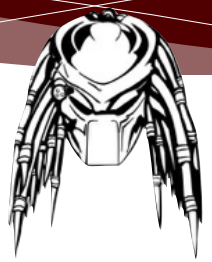


Banker plants

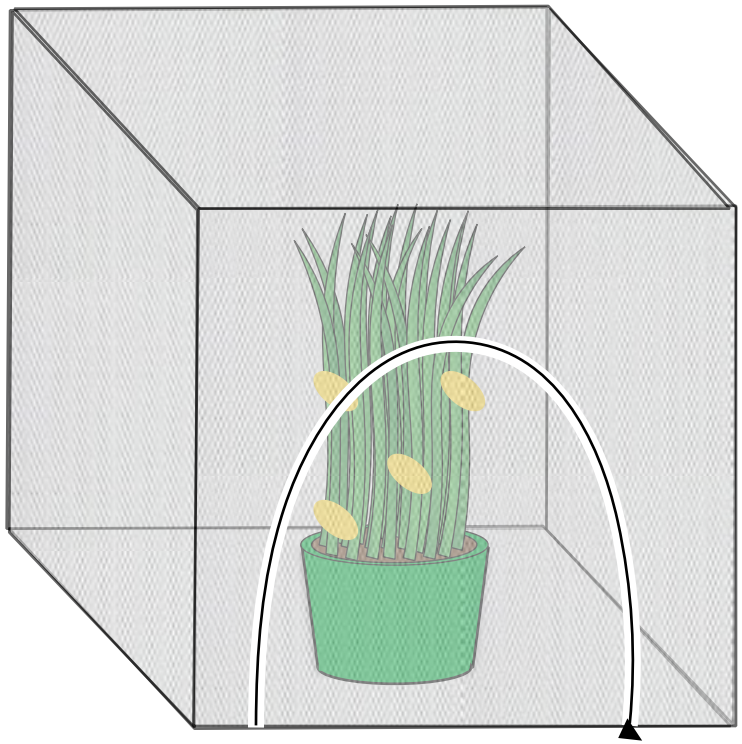


TEXAS A&M AGRILIFE EXTENSION

Biological Control | Predators

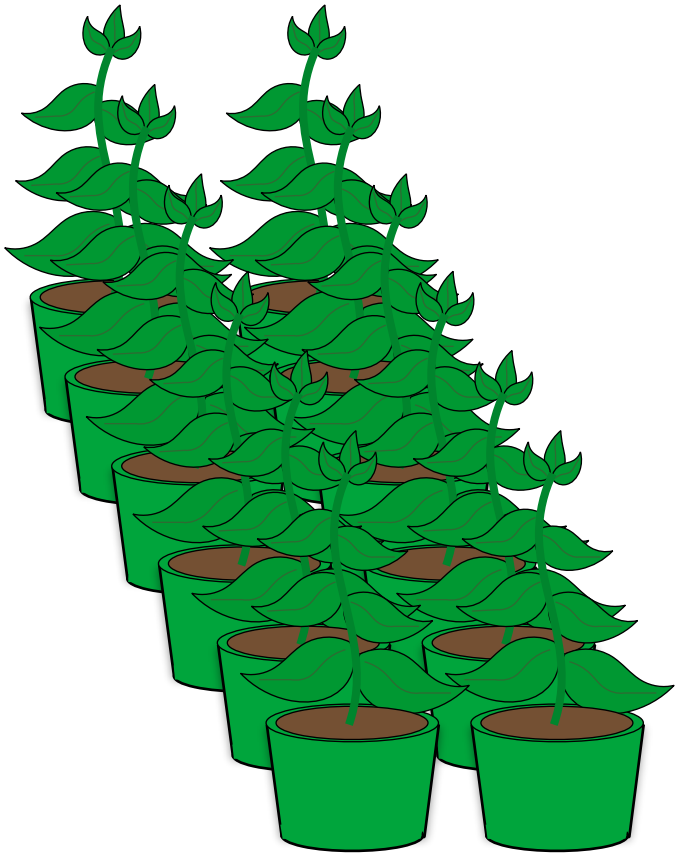


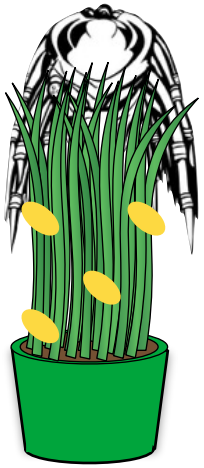
Banker plants



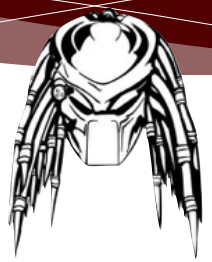
Biological Control | Predators

Banker plants



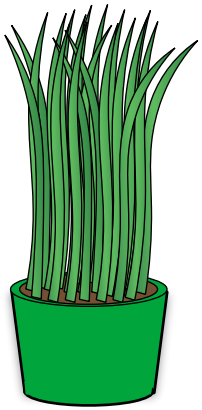


Biological Control | Predators

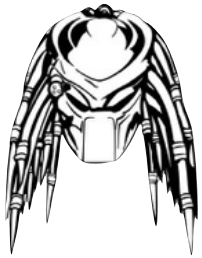


Banker plants

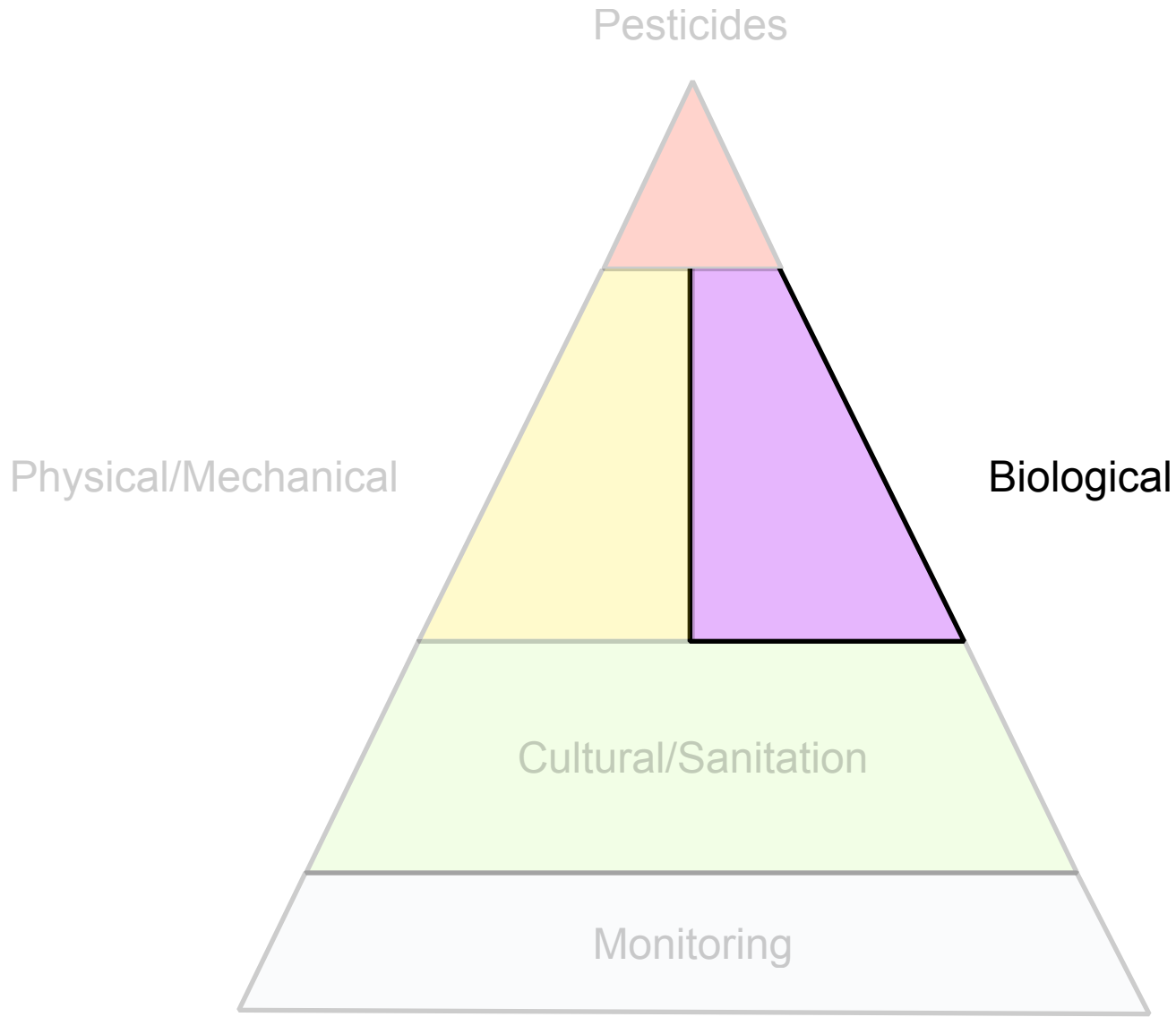
- Cereal aphids[1], bird cherry oat aphids[2,3], greenbug[5]

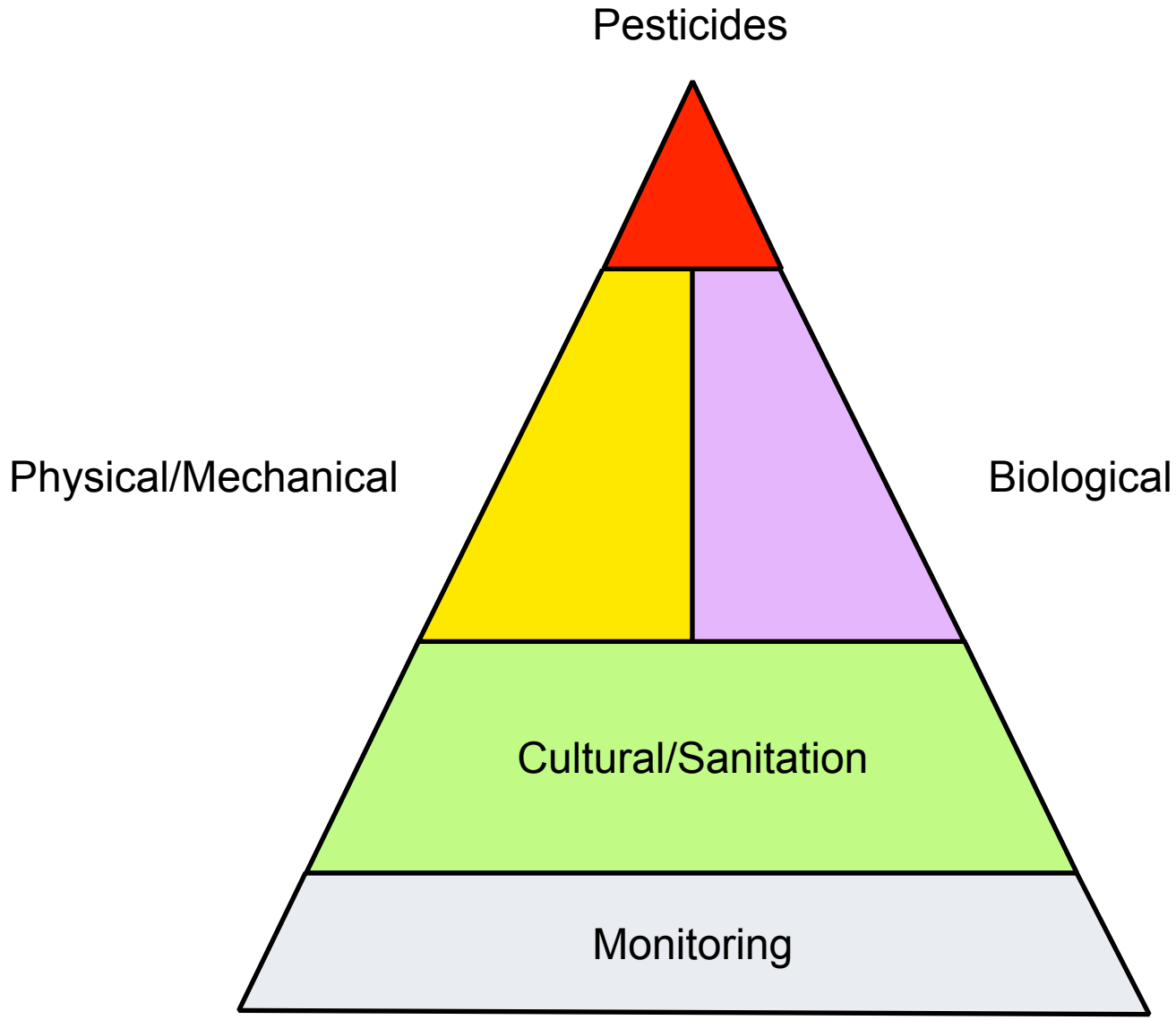


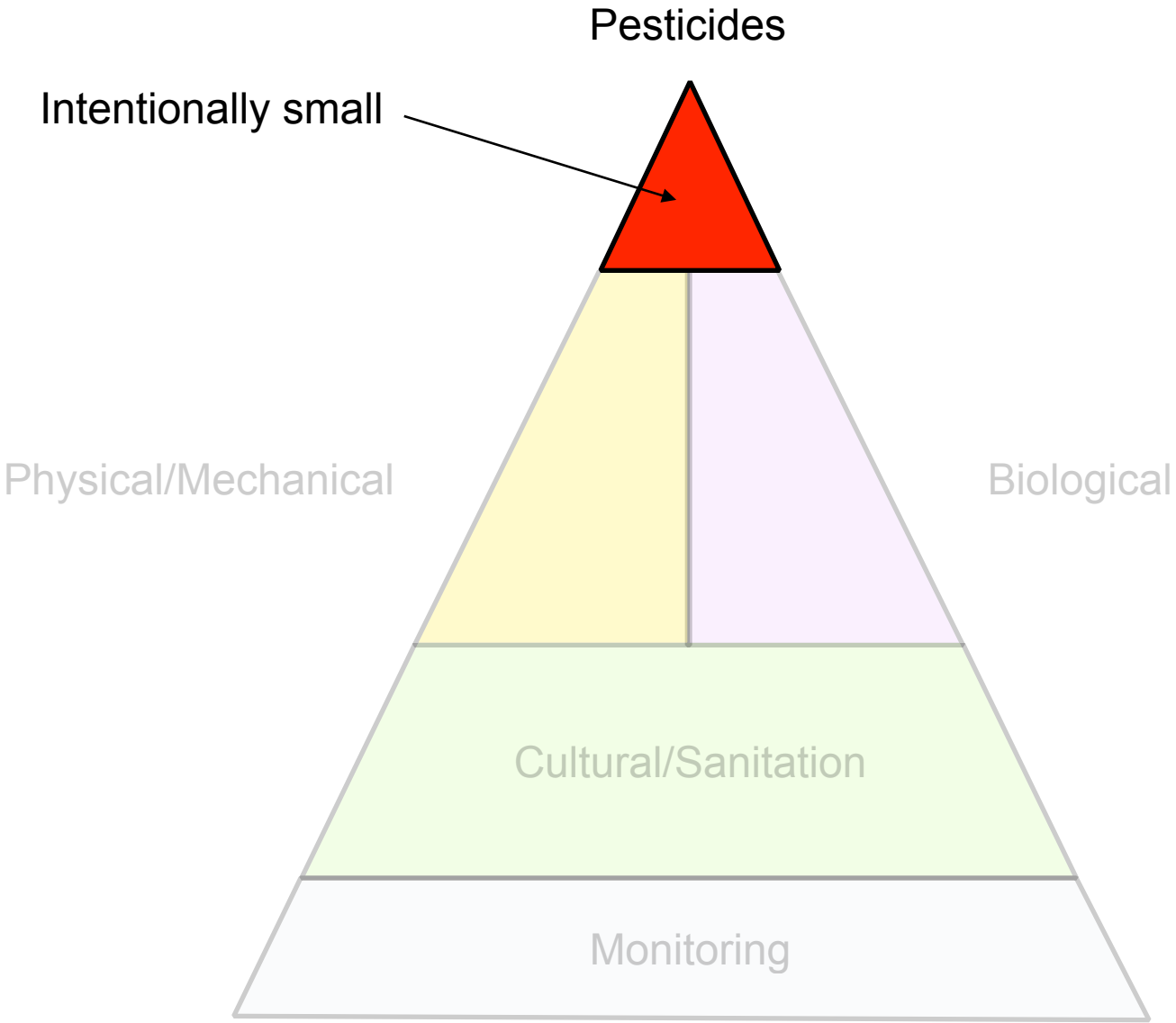
Cereal plants: barley[2], rye[4], wheat[5], barley[5], maize[5], sorghum[5]



Parasitic wasps: *Aphidius ervi*[1,4], *A. matricariae*[2], *A. colemani*[2,3,4,5]

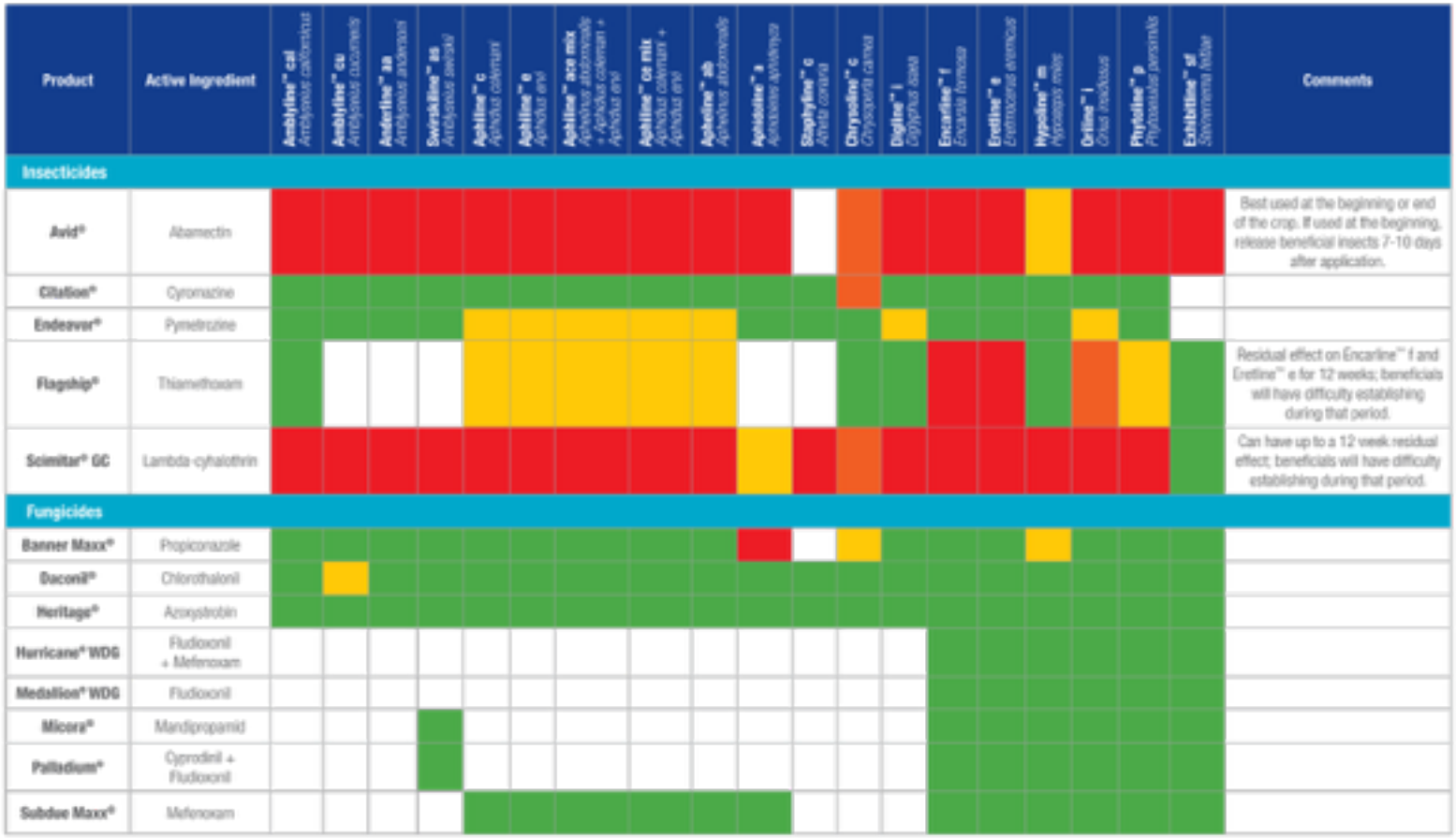






Pesticides

COMPATIBILITY CHART FOR SYNGENTA BIOLINE™ BIOLOGICAL CONTROL AGENTS AND PLANT PROTECTION PRODUCTS



Class	Population Effect
1	0-25% reduction
2	26-50% reduction
3	51-75% reduction
4	>75% reduction

Note: Unclassified products have not been fully tested. Test unclassified products on a small scale basis and evaluate for effect prior to widespread use.

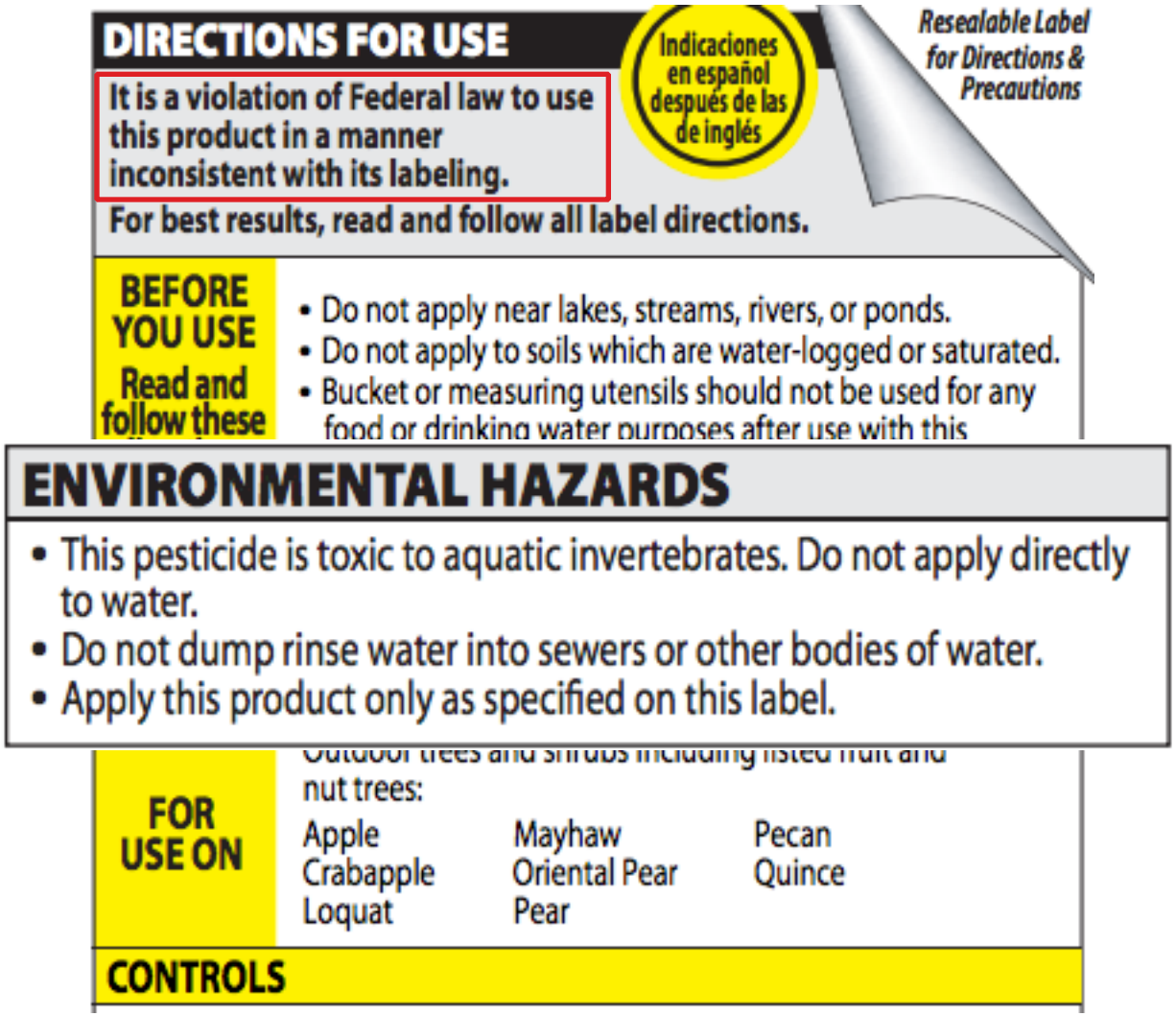
For more information about Bioline, please visit www.syngentabiolines.com or contact your local Syngenta representative.

TEXAS A&M AGRILIFE EXTENSION

Bioline

syngenta

Pesticide labels



DIRECTIONS FOR USE

Indicaciones en español después de las de inglés

Resealable Label for Directions & Precautions

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For best results, read and follow all label directions.

BEFORE YOU USE

Read and follow these

- Do not apply near lakes, streams, rivers, or ponds.
- Do not apply to soils which are water-logged or saturated.
- Bucket or measuring utensils should not be used for any food or drinking water purposes after use with this

ENVIRONMENTAL HAZARDS

- This pesticide is toxic to aquatic invertebrates. Do not apply directly to water.
- Do not dump rinse water into sewers or other bodies of water.
- Apply this product only as specified on this label.

FOR USE ON

Outdoor trees and shrubs including listed fruit and nut trees:

Apple	Mayhaw	Pecan
Crabapple	Oriental Pear	Quince
Loquat	Pear	

CONTROLS

TEXAS A&M AGRILIFE EXTENSION

Pesticide labels

ENVIRONMENTAL HAZARDS

This product is highly toxic to aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters. Apply this product only as specified on this label. Extreme care must be taken to avoid runoff. Apply only to soil or other fill substrate that will accept the solutions at the specified rate. Do not treat soil that is water-saturated or frozen, or in any conditions where run-off or movement from the treated area (site) is likely to occur.

This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area. This chemical demonstrates the properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

Do not formulate this product into other end-use products.

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. Pesticide incidents can also be reported to the National Pesticide Information Center at: www.npic.orst.edu or directly to EPA at: 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.

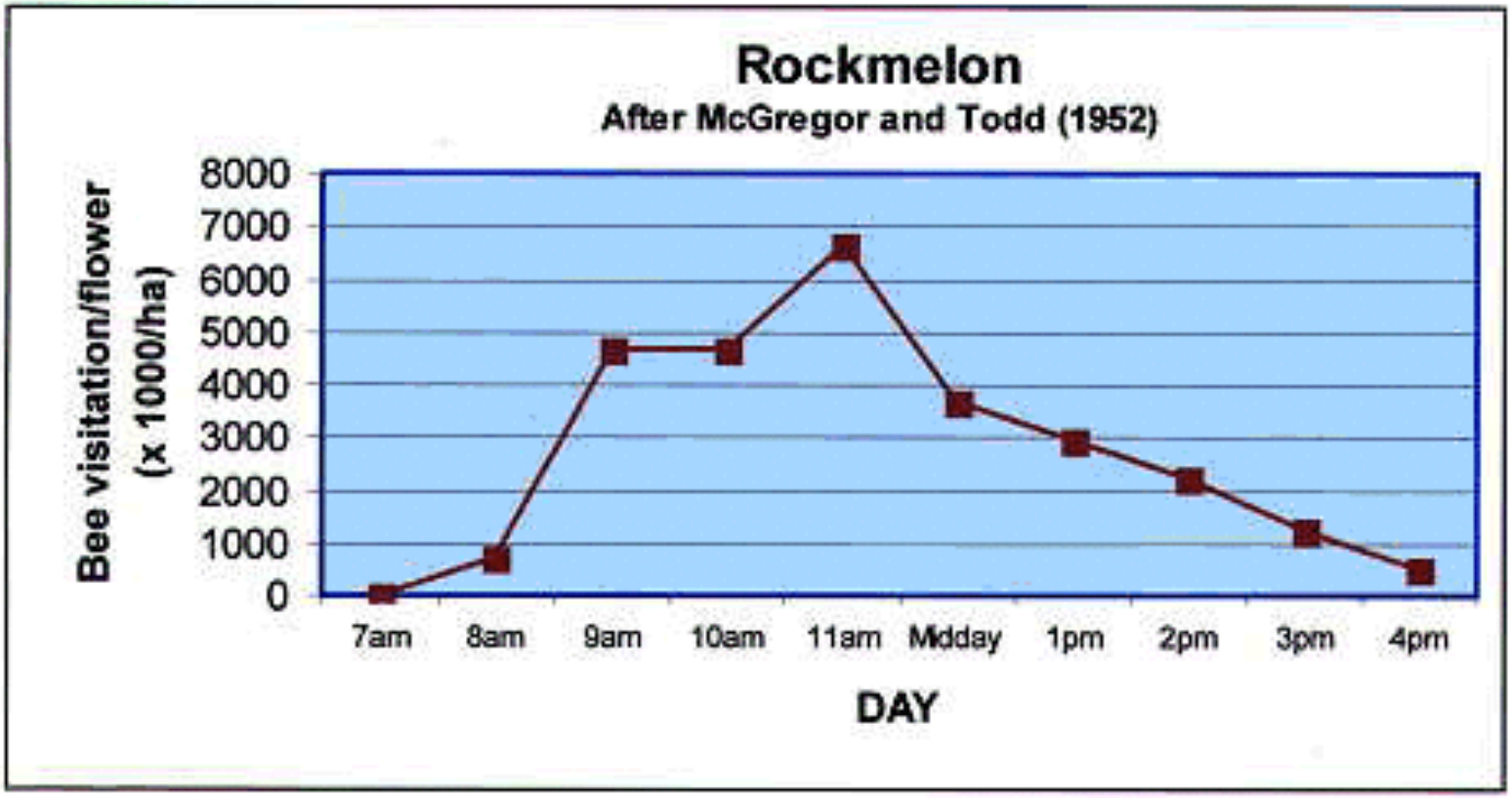
Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

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.

EPA

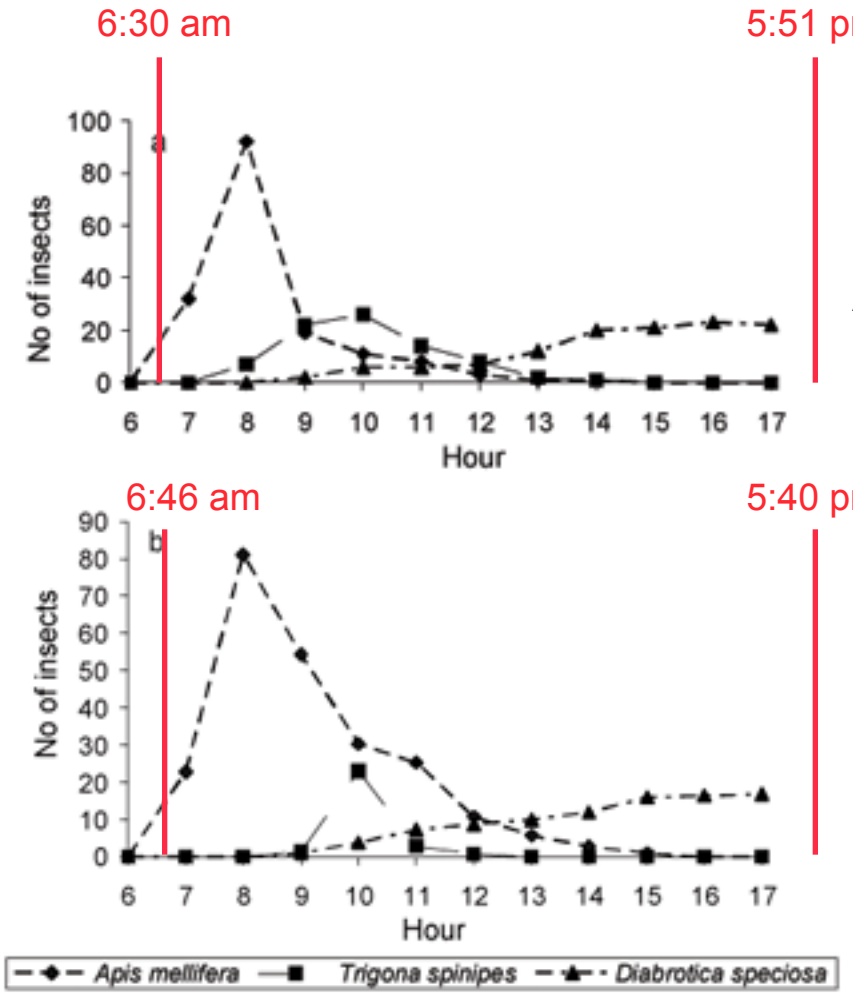
Read EPA's new and strengthened label requirements: http://go.usa.gov/jHH4

Timing



Timing

Nicodemo et al. (2009) Honey Bee as an effective pollinating agent of pumpkin. *Sci Agric.*, 66: 476 - 480.



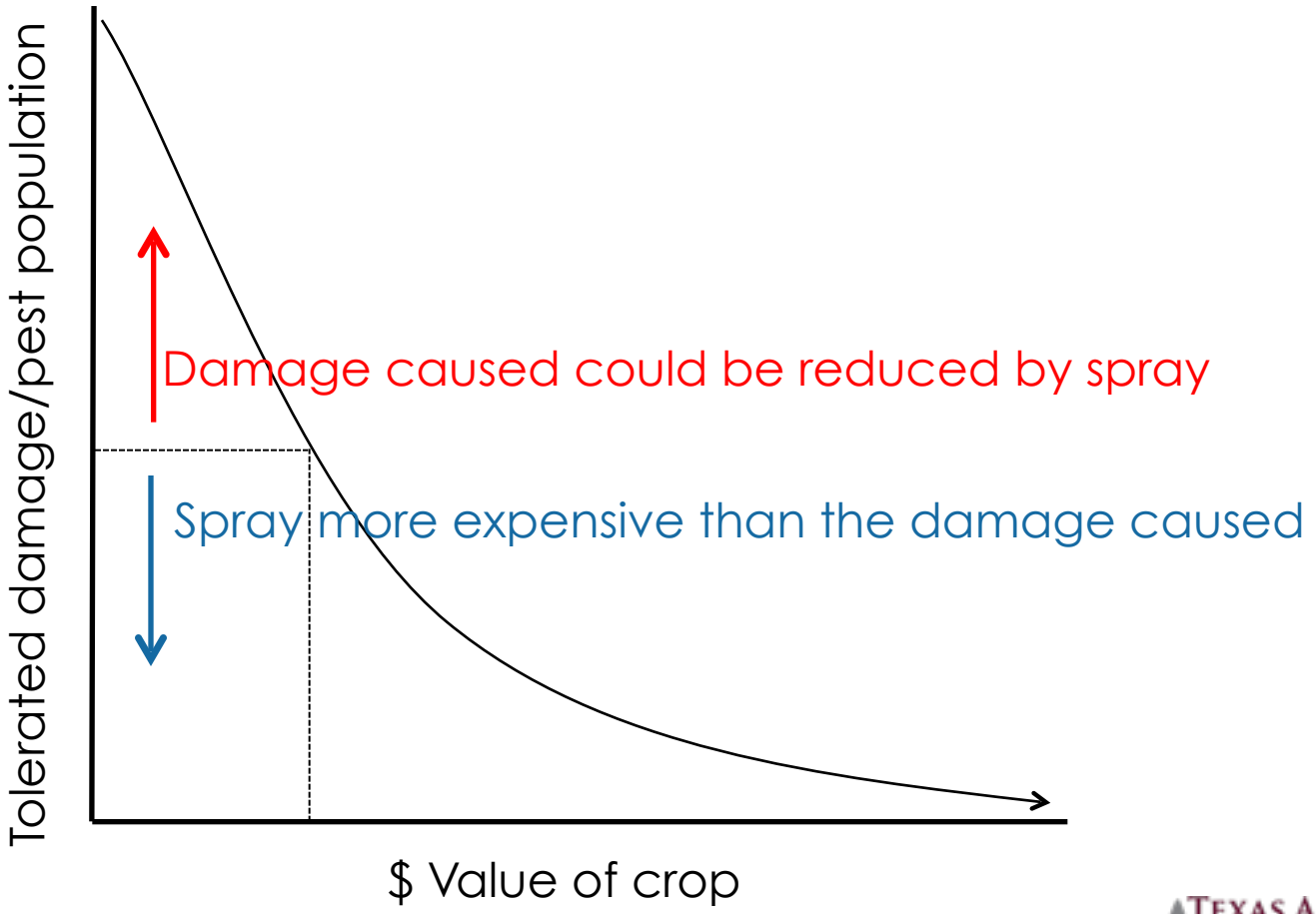
Sunrise/Sunset
August 18, 2001
São Paulo, Brazil

Sunrise/Sunset
July 23, 2002
São Paulo, Brazil

Figure 1 - Most frequent insects found on flowers of pumpkin (*Cucurbita maxima*), at different hours in 2001 (A) and 2002 (B).

TEXAS A&M AGRILIFE EXTENSION

Economic Threshold & Monitoring



TEXAS A&M AGRILIFE EXTENSION

Thank you

Erfan Vafaie
Extension Program Specialist, IPM

erfan.vafaie@ag.tamu.edu
(O) 903-834-6191
sixleggedaggie.com

TEXAS A&M AGRILIFE EXTENSION

Case | California Cut Roses

Case | California Cut Roses

Western flower thrips

A&M LIFE EXTENSION

Case | California Cut Roses

Scouting:

- Sampled a leaf on 38 randomly selected plants per 10,000 sq. ft.
- Directed sampling as walking up and down rows
- Five mobile mites or more considered infested
- Record co-occurrence with natural predators

Thresholds:

TABLE 1. Control actions for twospotted spider mite based on percentage of infested plants

Mite density	Action
% samples infested	
0–10	Do nothing
> 10–25*	Biological control (*Phytoseiulus persimilis*), with release rate based on proportion of co-occurrence of mites and predators
> 25	Chemical controls

* 25% infested = 4.5 *T. urticae*/leaf.

Twospotted spider mite

A&M LIFE EXTENSION

Case | California Cut Roses

Chemical controls:

- Azadirachtin
- Bifenazate
- Insecticidal soap

Twospotted spider mite

TABLE 1. Control actions for twospotted spider mite based on percentage of infested plants

Mite density	Action
% samples infested	
0–10	Do nothing
> 10–25*	Biological control *(Phytoseiulus persimilis)*, with release rate based on proportion of co-occurrence of mites and predators
> 25	Chemical controls

* 25% infested = 4.5 *T. urticae*/leaf.

Case | California Cut Roses

Scouting:
- One sticky trap (4"x6") per 10,000 sq. ft., collected weekly

Thresholds:
- 25 – 50 thrips per trap per week

Control
- Routine flower harvest
- Lower-volume directed applications of spinosad and azadirachtin

Western flower thrips

University of Georgia
EXTENSION

Case | California Cut Roses

Scouting:

- Grapevine mildew model (GMM)
- Temperature, humidity and leaf wetness model to predict favorable conditions for powdery mildew
- Walk-through to determine disease incidence.

Thresholds:

- 0 tolerance.

Control

- Myclobutanil
- Chlorothalonil
- Benzeneacetic acid
- Azoxystrobin
- Insecticidal soap
- Potassium bicarbonate

EXTENSION

Case | California Cut Roses

Successes

TABLE 2. Miticide costs under conventional control, IPM startup (first 4 to 8 weeks) and IPM maintenance

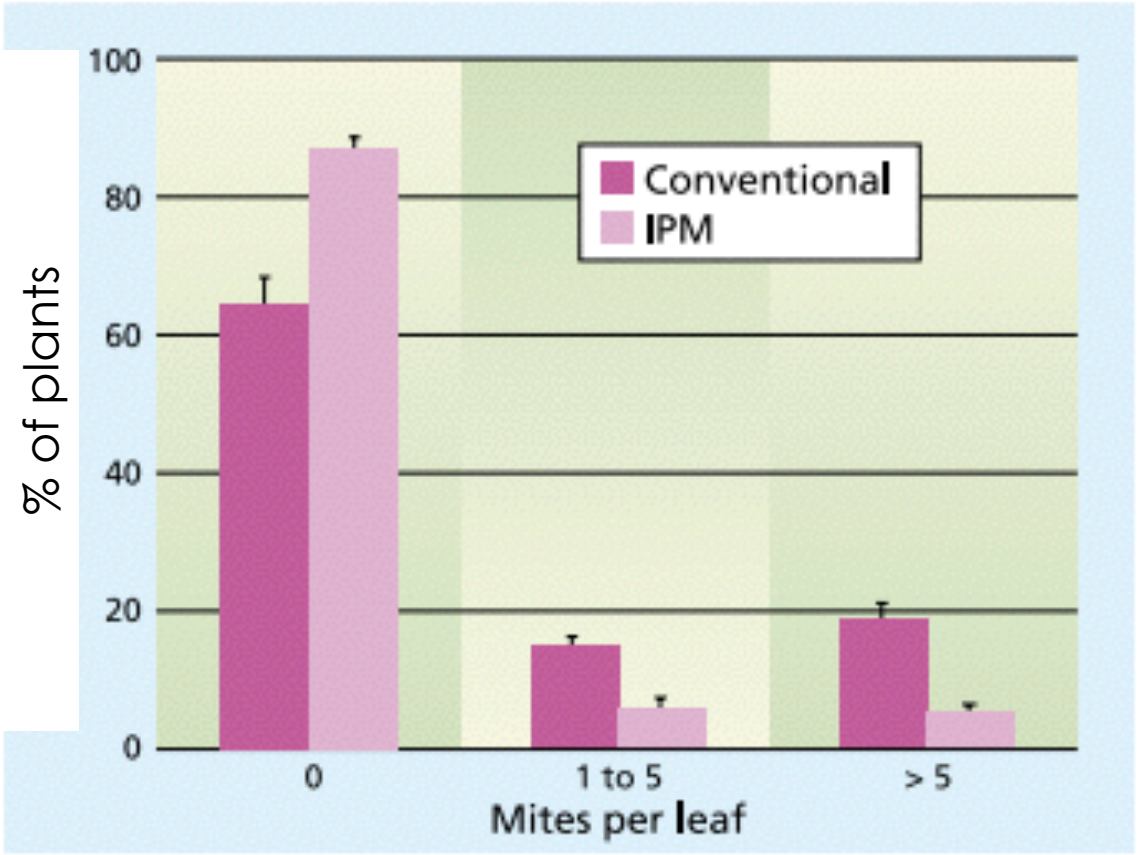
Treatment	Cost/ft²/ application	Amount used per application*
Conventional	$0.006 to $0.01	100 to 150 gallons
IPM startup	$0.02 to $0.03	1 to 50 vials
IPM maintenance	$0.005 to $0.008	2 to 5 vials

* Per 10,000 square feet; one vial contains 2,000 *Phytoseiulus persimilis*.

TEXAS A&M AGRILIFE EXTENSION

Case | California Cut Roses

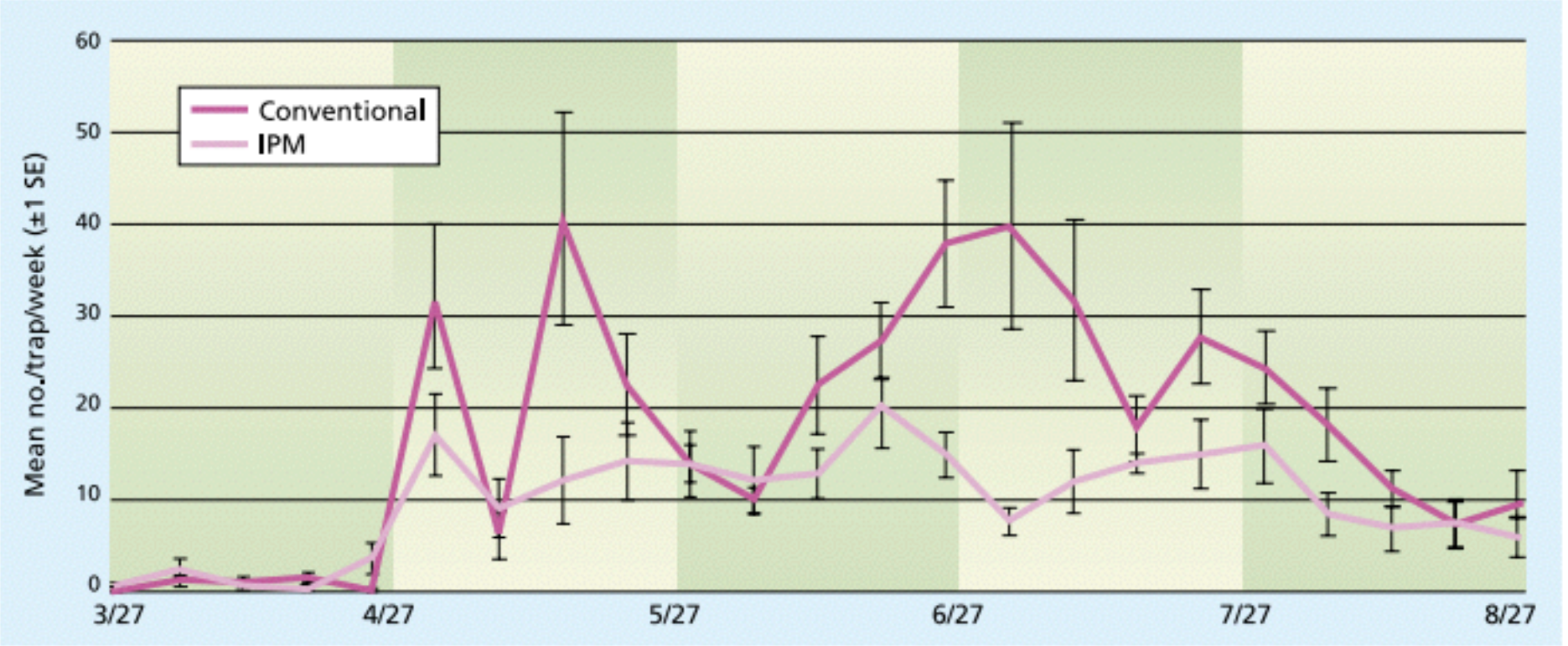
Successes



TEXAS A&M AGRILIFE EXTENSION

Case | California Cut Roses

Successes



Western Flower Thrips

TEXAS A&M AGRILIFE EXTENSION

Case | California Cut Roses

Challenges

Secondary pests (Citrus mealybug)

Transition period

Powdery mildew

Thank you

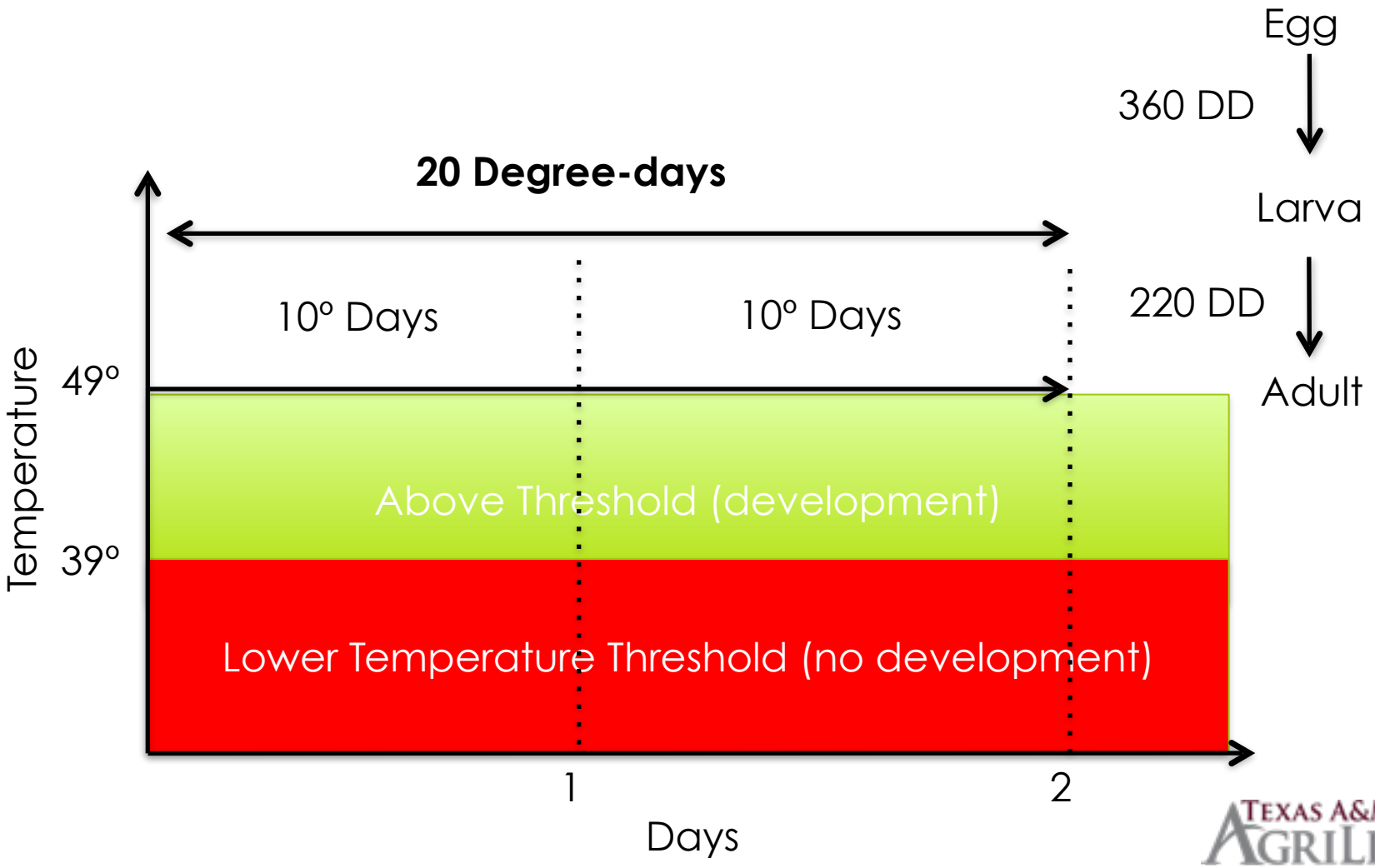
Erfan Vafaie
Extension Program Specialist, IPM

erfan.vafaie@ag.tamu.edu
(O) 903-834-6191
sixleggedaggie.com

TEXAS A&M AGRILIFE EXTENSION

Monitoring

Forecasting: Degree-day models



Texas A&M AgriLife Extension

Monitoring

Forecasting: Degree-day models

1. 261 DDs afte
2. 510 DDs afte
3. 565 DDs afte
4. 755 DDs afte
5. 995 DDs afte
6. 1249 DDs afte
7. 1489 DDs afte
8. 1743 DDs afte
9. 1983 DDs afte
10. 2237 DDs afte
11. 2477 DDs afte
12. 2731 DDs afte
13. 2971 DDs afte

spotted wing Drosophila model - OSU vers. 2.0

Location: 2014 APLT2 PALESTINE TX

DD accumulation on 2-9-14: 127. QA 100% ok - show details

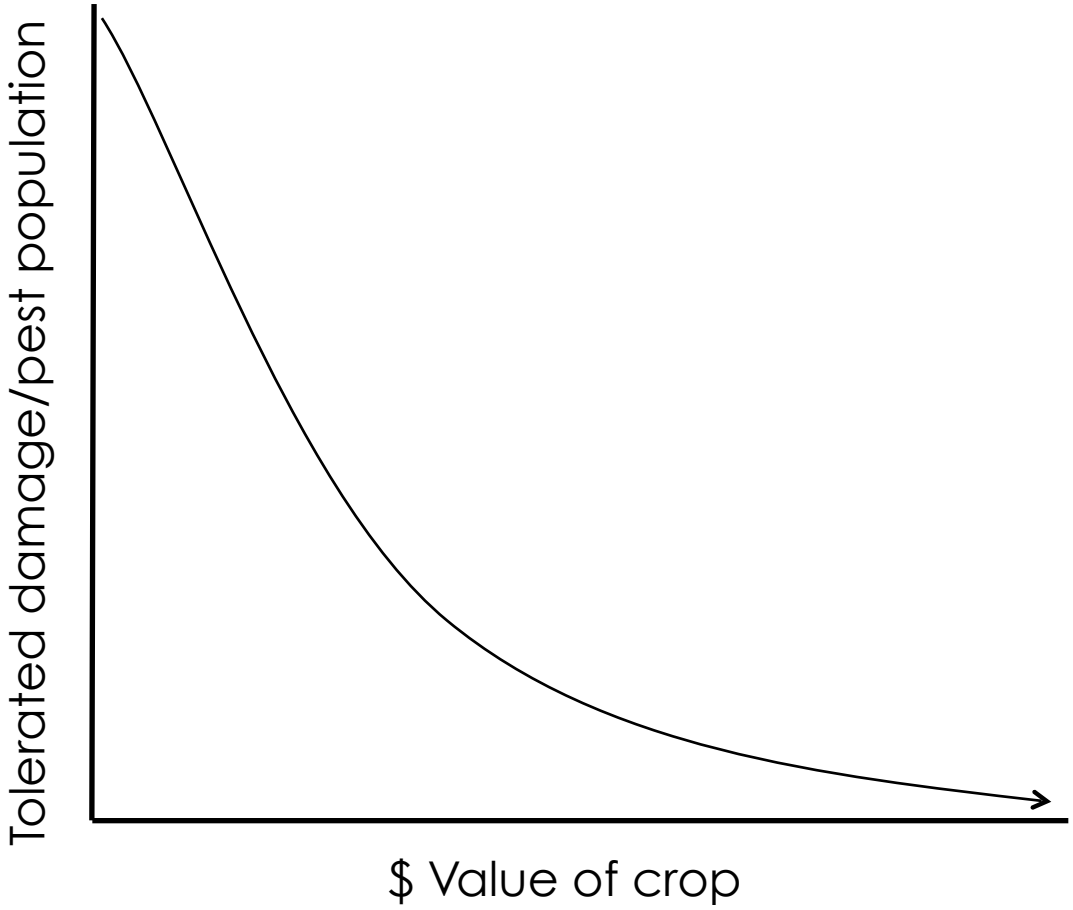
This year is about	versus	QA
13 days behind	2013	ok
19 days behind	2012	ok
13 days ahead	30-yr normal	ok

Date	DDs	Event
3-10-14	265	1st EGG LAYING BY OW FEMALES
4-7-14	522	PEAK (ca. 50%) EGG LAYING BY OW FEMALES; 1st ADULT EMERGE 1st GEN
4-11-14	571	1st EGG LAYING BY 1st GEN FEMALES
4-24-14	763	PEAK ADULT EMERGE 1st GEN
5-7-14	1002	PEAK EGG LAYING BY 1st GEN FEMALES; MAX 2+ GENS.
5-19-14	1264	PEAK ADULT EMERGE 2nd GEN; MAX 3+ GENS.
5-29-14	1510	PEAK EGG LAYING BY 2nd GEN FEMALES; MAX 4+ GENS.
6-7-14	1749	PEAK ADULT EMERGE 3rd GEN; MAX 5 GENS.
6-16-14	2003	PEAK EGG LAYING BY 3rd GEN FEMALES; MAX 6+ GENS.
6-24-14	2237	PEAK ADULT EMERGE 4th GEN; MAX 6+ GENS.
7-2-14	2479	PEAK EGG LAYING BY 4th GEN FEMALES; MAX 7+ GENS.
7-11-14	2757	PEAK ADULT EMERGE 5th GEN; MAX 8+ GENS.
7-18-14	2977	PEAK EGG LAYING BY 5th GEN FEMALES; MAX 9+ GENS.

RGE 1st GEN

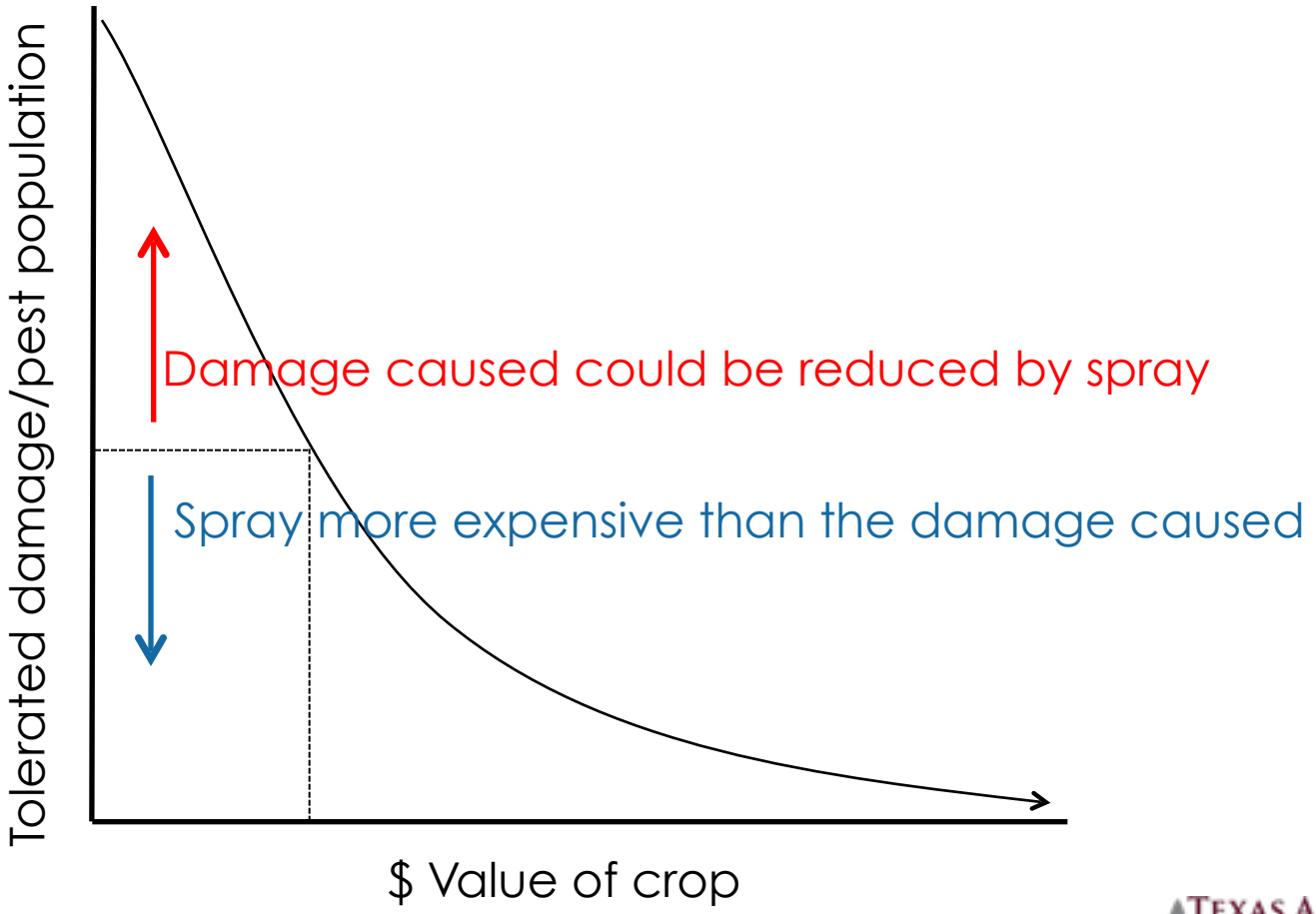
TEXAS A&M AGRILIFE EXTENSION

Economic Thresholds



Texas A&M AgriLife Extension

Economic Thresholds



TEXAS A&M AGRILIFE EXTENSION

Economic Thresholds