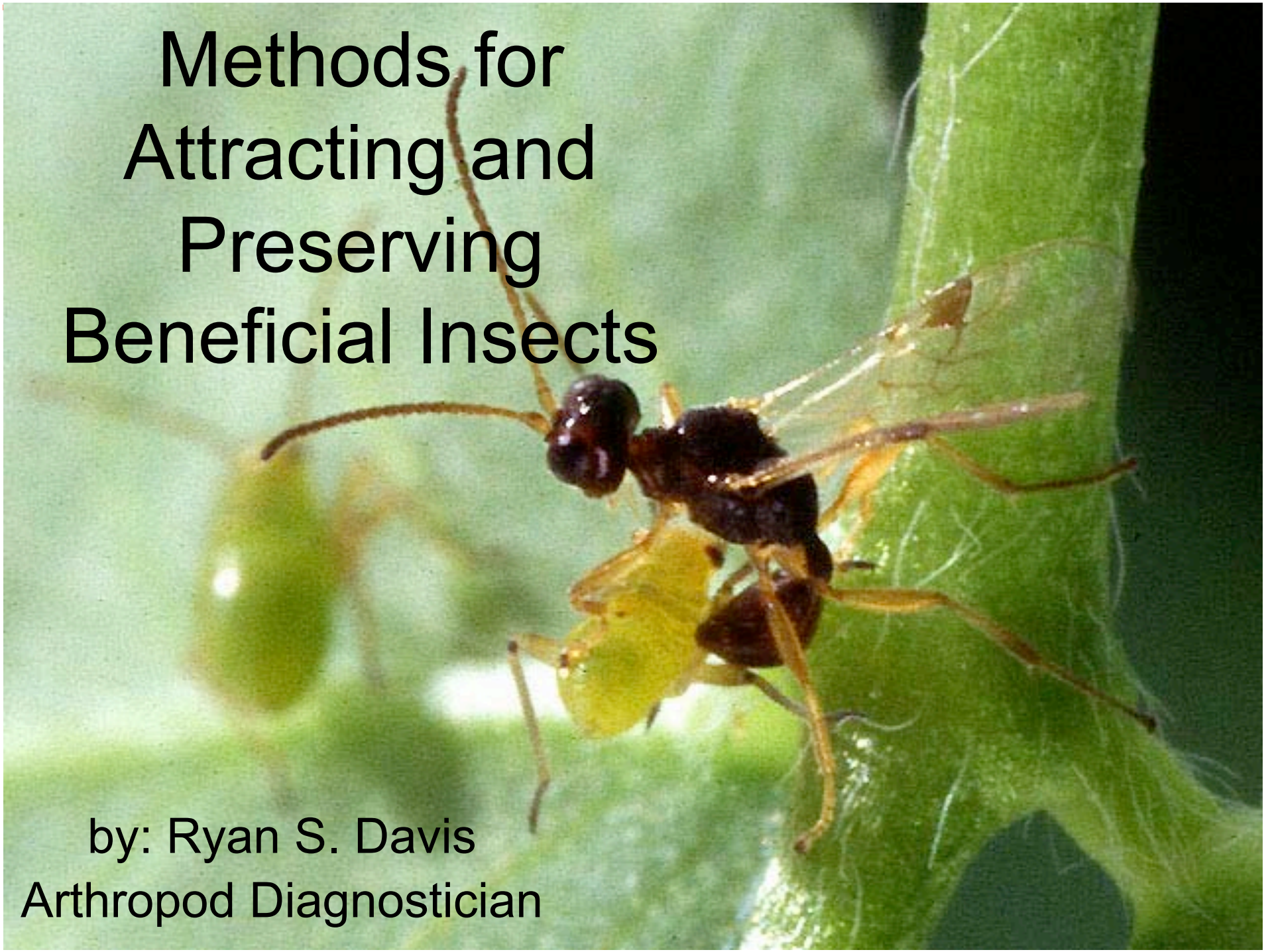
Methods for Attracting and Preserving Beneficial Insects



by: Ryan S. Davis
Arthropod Diagnostician

Outline

1) Biological control – basic concepts

2) Selecting the proper insecticides

3) Plants that attract beneficials

4) Identification of beneficials

800-346-9140

ATTRA

Appropriate Technology Transfer for Rural Areas

www.attra.org

FARMSCAPING

TO ENHANCE BIOLOGICAL CONTROL

PEST MANAGEMENT SYSTEMS GUIDE

ATTRA is the national sustainable agriculture information center funded by the USDA's Rural Business—Cooperative Service.

by Rex Dufour
NCAT Agriculture Specialist
December 2000

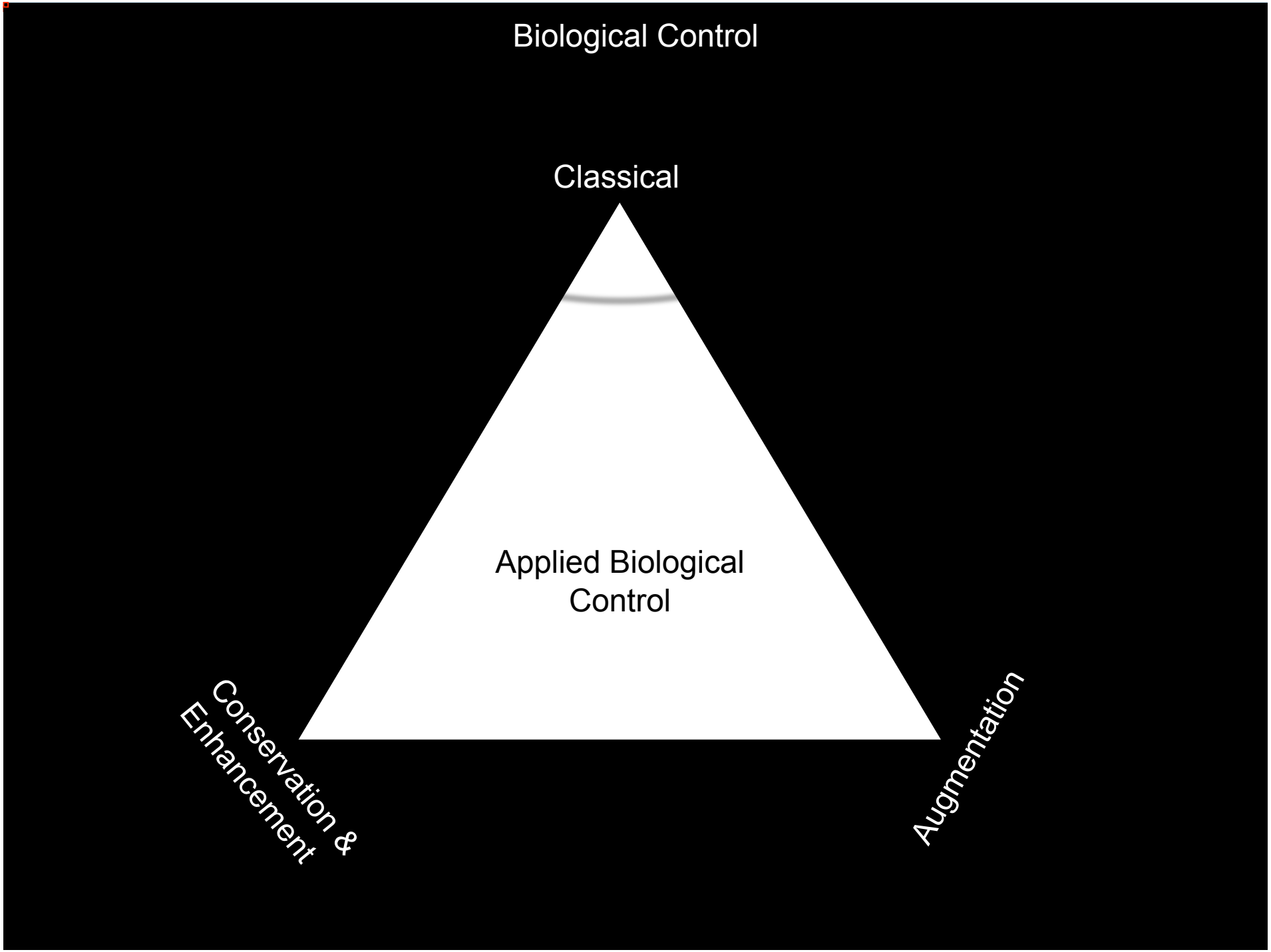
Hedgerow of insectary plants at Fong Farms Ltd. in Woodland, CA.

Abstract: *This publication contains information about increasing and managing biodiversity on a farm to favor beneficial organisms, with emphasis on beneficial insects. The types of information farmscapers need to consider is outlined and emphasized. Appendices have information about various types and examples of successful "farmscaping" (manipulations of the agricultural ecosystem), plants that attract beneficials, pests and their predators, seed blends to attract beneficial insects, examples of farmscaping, hedgerow establishment and maintenance budgets, and a sample flowering period table.*

CONTENTS

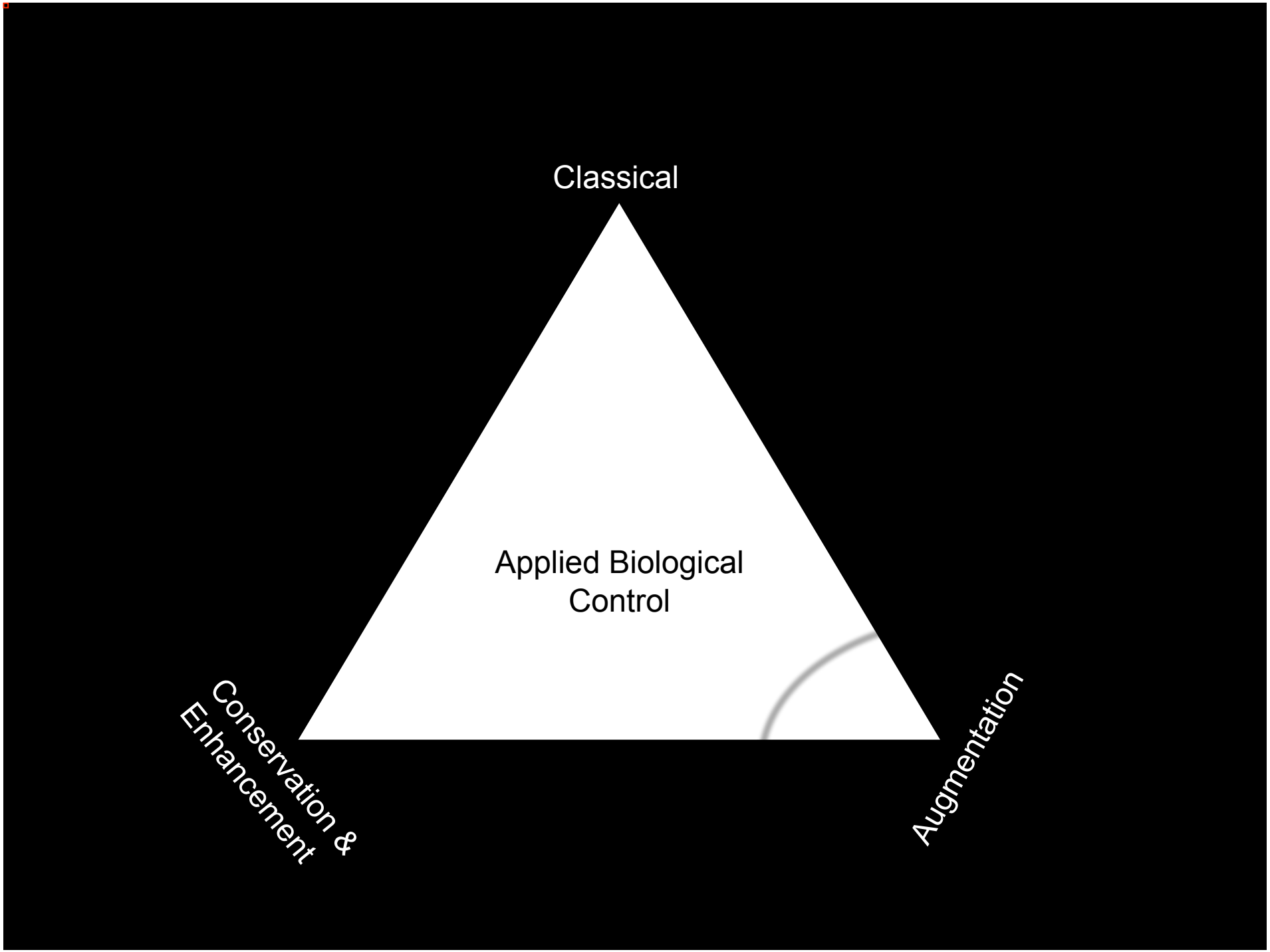
ATTRA:
Farmscaping

http://
attra.ncat.org/
attra-pub/
farmscape.html


Biological Control
Classical
Applied Biological Control
Conservation & Enhancement
Augmentation

Classic, or importation biological control: includes the deliberate introduction and establishment of exotic natural enemies into areas where they did not previously occur.

Vedalia beetle against cottony cushion scale in CA.


Classical
Applied Biological Control
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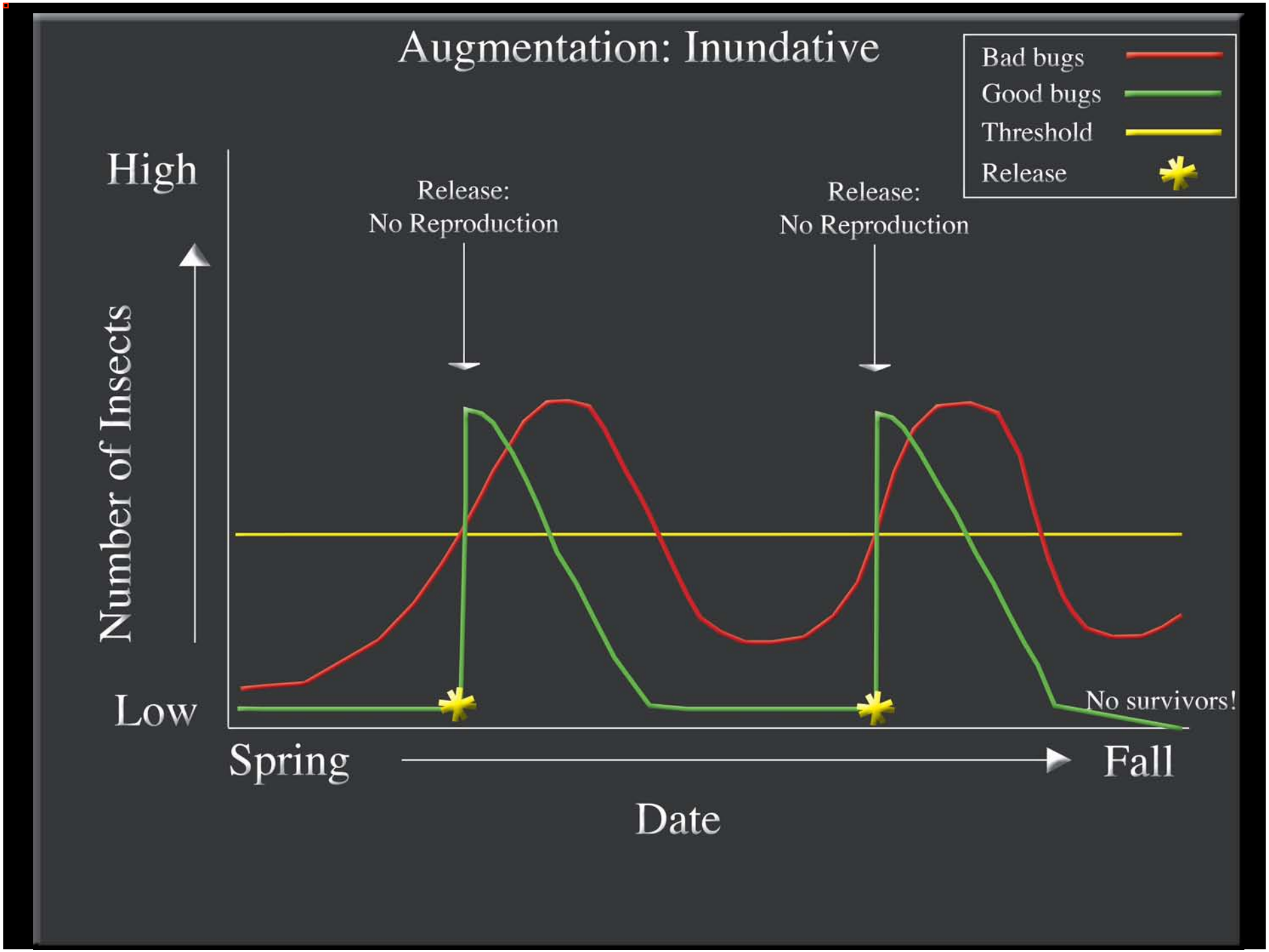
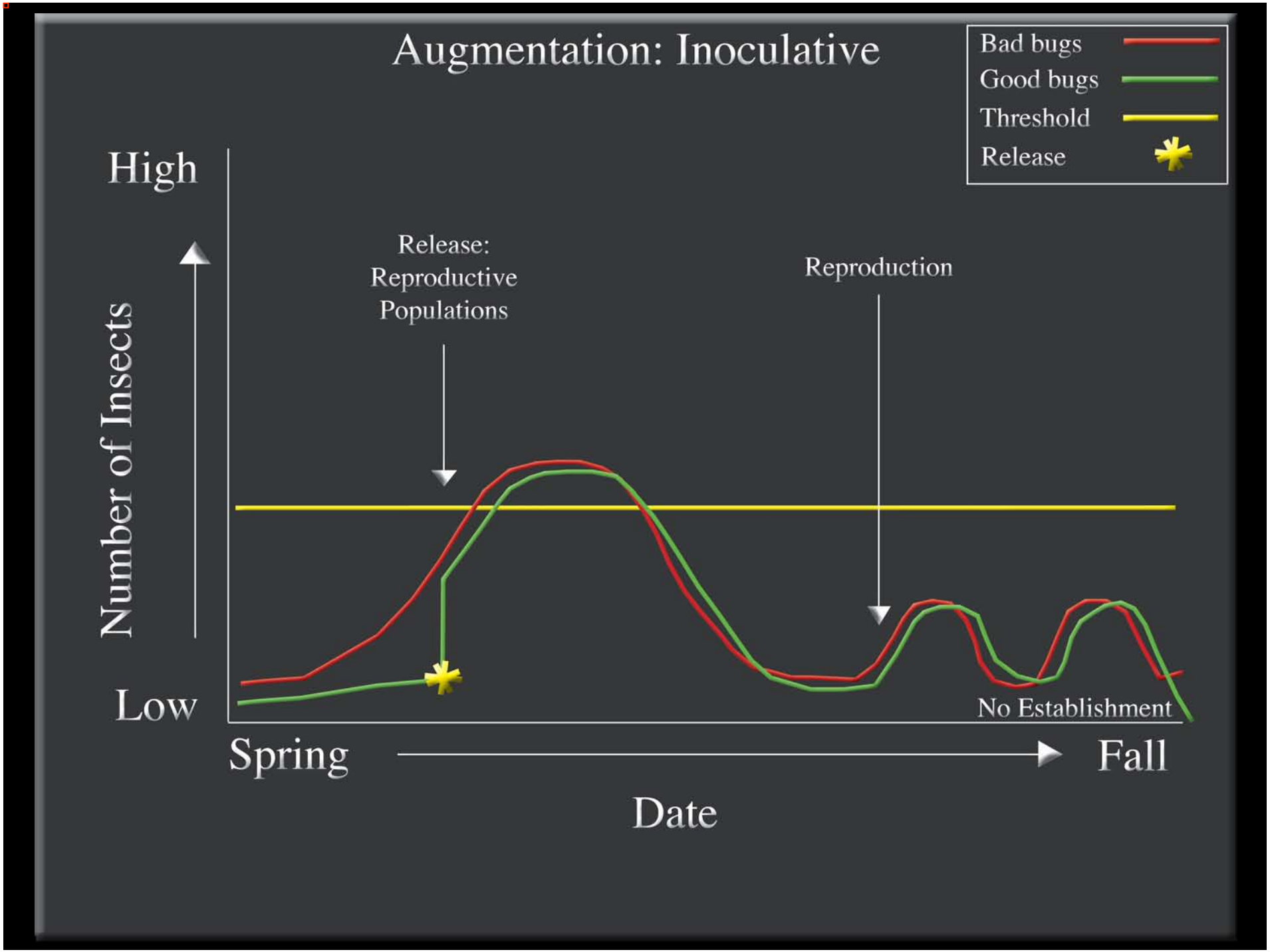

Augmentation: Inundative
Bad bugs
Good bugs
Threshold
Release
High
Low
Number of Insects
Release:
No Reproduction
Release:
No Reproduction
No survivors!
Spring
Fall
Date


Augmentation: Inoculative
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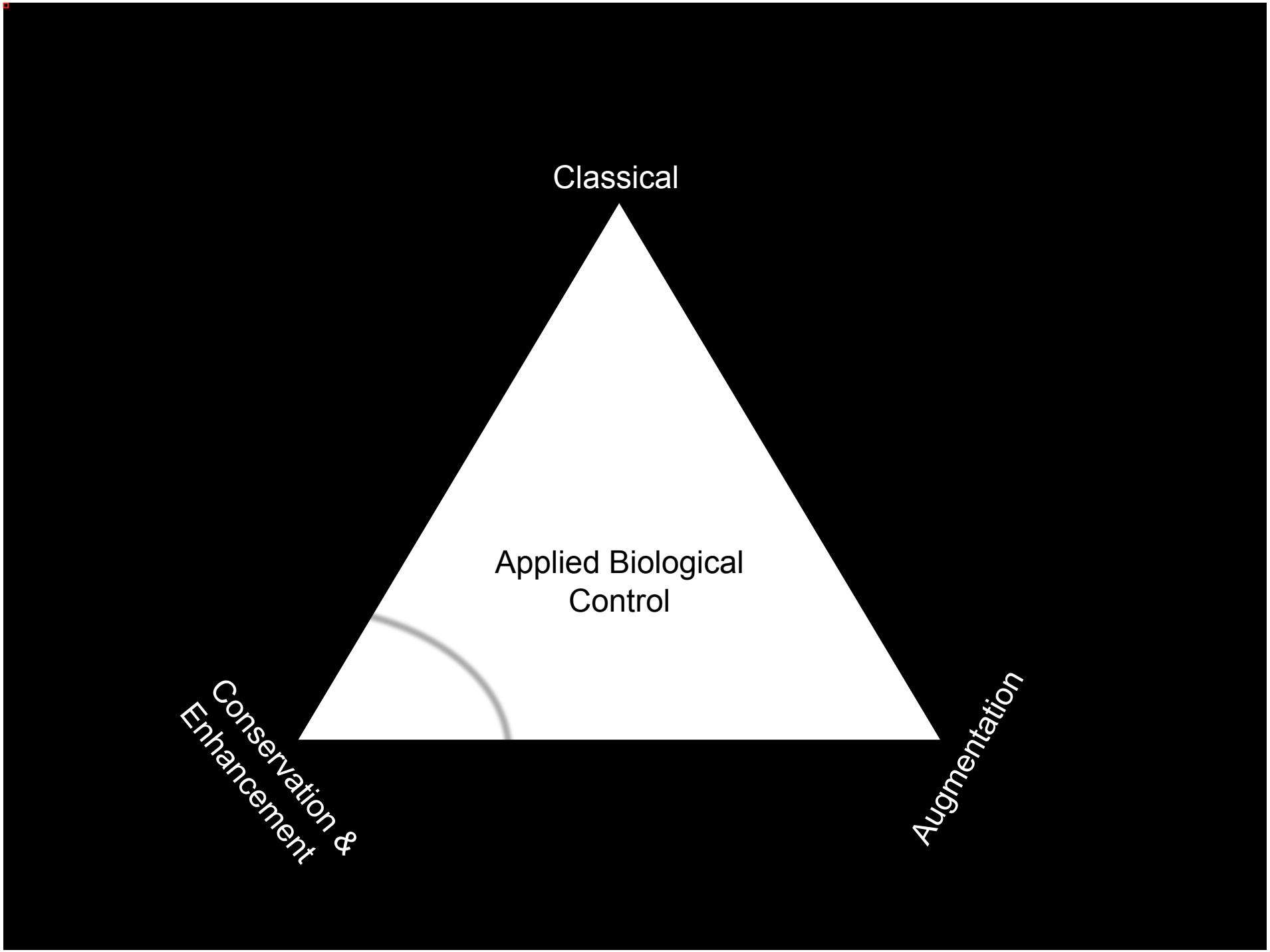

Classical
Applied Biological Control
Conservation & Enhancement
Augmentation

Conservation and enhancement:

1. Avoid using broad-spectrum insecticides (IPM).

2. Provide shelter, alternative food sources, overwintering sites for larvae/ nymphs and adult beneficials (farmscaping).

Appropriate Technology Transfer for Rural Areas (ATTRA)

http://www.attra.org

“Farmscaping to Enhance Biological Control”

Chemical Control

- Two general categories: Broad-spectrum & Selective

Mosquitos

Cyper TC

Bonide Mosquito Beater WSP

Cypermethrin Kills 47 pests from:	
Coleoptera	Hymenoptera
Blattaria	Heteroptera
Diplopoda	Acari
Orthoptera	Isoptera
Dermaptera	Thysanura
Siphonaptera	Diptera
Lepidoptera	Aranae

***Bt isr*. Kills 1 pests from:**
Diptera

Selective!

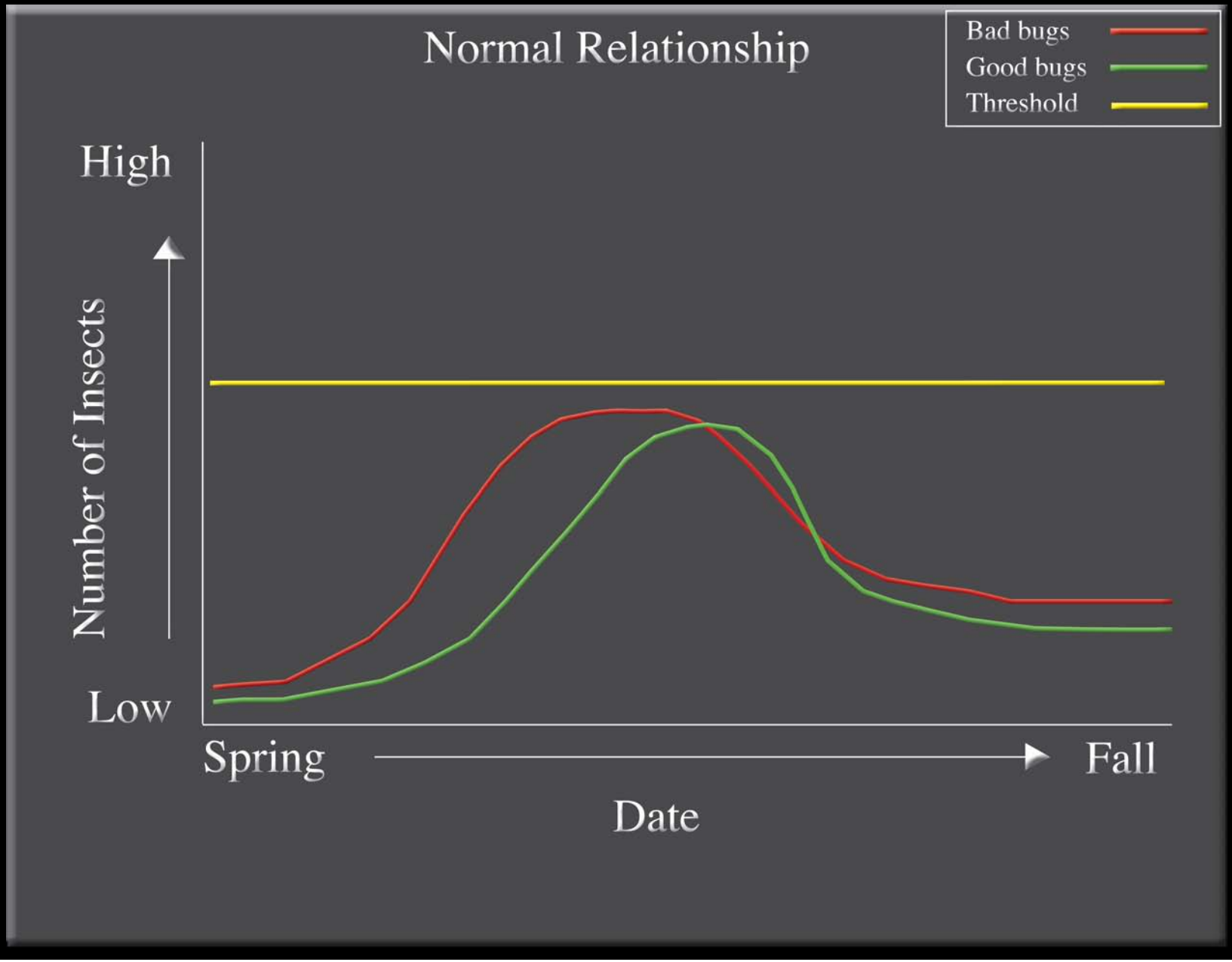
Chemical control

Avoid using broad-spectrum insecticides

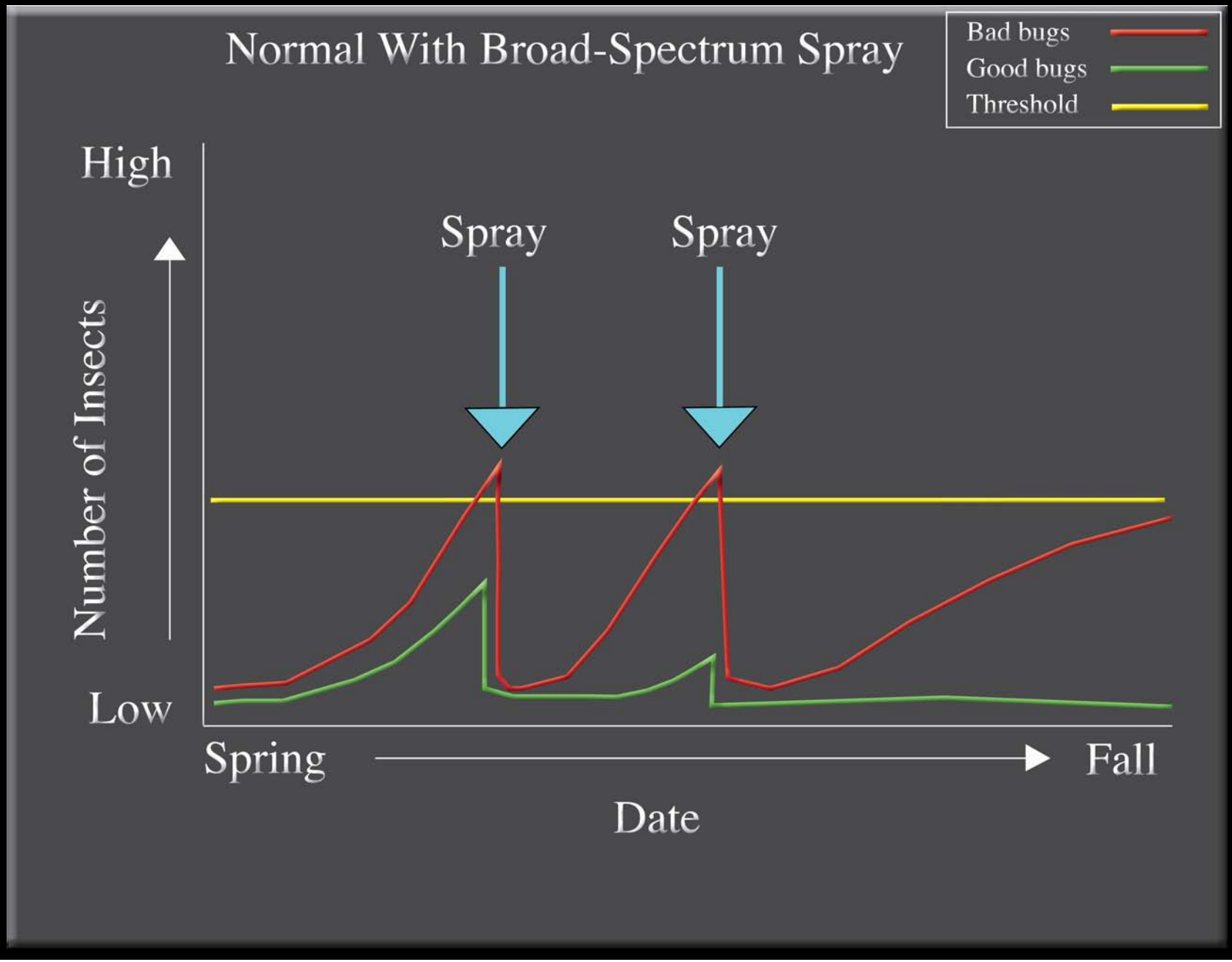
Sub-Group	Sub-Group Name	Active Ingredients
1A	Carbamates	Carbaryl, Bendiocarb,
1B	Organophosphates	Acephate, Diazinon
2A	Organochlorines	Endosulfan, Chlordane
3A	Pyrethroids	Bifenthrin Esfenvalerate
4A	Neonicotinoids	Imidacloprid (foliar)

Why?

Broad-spectrum insecticides can destroy beneficials.



Broad-spectrum insecticides can destroy beneficials.



Chemical Control

- Two general categories: Broad-spectrum & Selective

Cyper TC

Conserve SC

Cypermethrin Kills 47 pests from:	
Coleoptera	Hymenoptera
Blattaria	Heteroptera
Diplopoda	Acari
Orthoptera	Isoptera
Dermaptera	Thysanura
Siphonaptera	Diptera
Lepidoptera	Aranae

Spinosad kills 77 pests from:	
Acari	Coleoptera
Dermaptera	Hymenoptera
Lepidoptera	Siphonaptera
Thysanoptera	

But…

Chemical Control

- Two general categories: Broad-spectrum & Selective

Beneficial Species	Spinosad LC 50	Cypermethrin LC 50
Honeybee	11.5 ppm	1.2 ppm
Whitefly parasitoid	29.1 ppm	1.9 ppm
Minute pirate bug	200 ppm	0.2 ppm
Lady beetle	>200 ppm	0.2 ppm
Lacewing	>200 ppm	<0.2 ppm
Predaceous mite	>200 ppm	<0.2 ppm

Chemical control

Broad-spectrum with selective formulations

Imidacloprid

Neonicotinoid

very toxic, but…

Systemic

Carbaryl

Carbamate

very toxic, but…

Bait

Chemical control

“Reduced risk” pesticides

Qualities of a reduced risk insecticide

– Selective
– Short residual
– Systemic

Examples

– microbial (bacteria, nematode, fungi, viruses)
– soap, oil, dust
– botanical (pyrethrum, nicotine, neem)

Selective Chemistries

Main Groups	Sub-Groups
1	Carbamates/ Organophosphates
2	Cyclodiene/organochlorines Phenylpyrazoles (Fiproles)
3	Pyrethroids/pyrethrins DDT/Methoxychlor
4	Neonicotinoids/Nicotine
5	Spinosyns
6	Avermectins/Milbemycins
7	Juvenile hormone analogues Fenoxycarb/pyrproxyfen
8	Methyl bromide/Chloropicrin/ Sulfuryl fluoride/borax/tartar emetic
9	Pymetrozine/Flonicamid
10	Clofentezine/Hexythiazox Etoxazole
11	*Bacillus thuringiensis*
12	Diafenthiuron/organotin miticides/Propargite/tetradifon
13	Chlorfenapyr

Main Groups	Sub-Groups
14	Nereistoxin analogues
15	Benzoylureas
16	Buprofezin
17	Cyromazine
18	Diacylhydrazines
19	Amitraz
20	Hydramethylnon/ Acequinocyl/ Fluacrypyrim
21	METI acaracides/ Rotenone
22	Indoxacarb/ metaflumizone
23	Tetronic and tetramic acid derivatives
24	Phospine/Cyanide
25	Vacant
26	Vacant
27	Vacant
28	Diamides

Planting to Promote Beneficials

Plant selection and application methods depend on your system:

1) Identify crop you want to plant.

2) What pests affect this crop?

3) What beneficials “prey” upon those pests?

4) What type of plants and habitat do those beneficials prefer?

Planting to Promote Beneficials

Plants must provide…

Food

(primary or secondary)

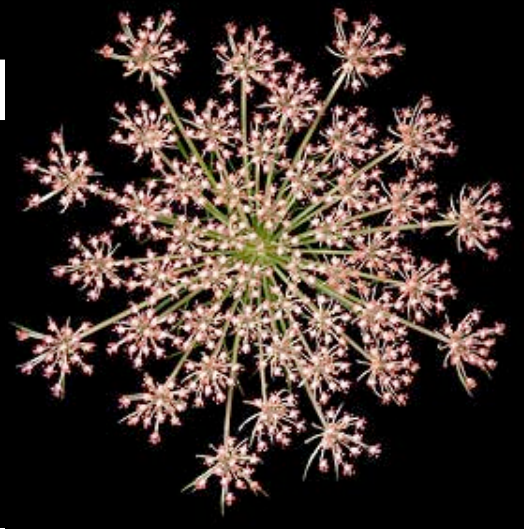
Shelter

(favorable microenvironment)

Planting to Promote Beneficials

Plant Characteristics

- Floral structure
  - Small, shallow flowers (umbels)
- Extrafloral nectaries
- Greater nectar and pollen production
- Trichomes



Attractive Flowers

Good plants to use:

Carrot Family (Umbelliferae)

- Queen Anne's Lace, dill, fennel parsley, coriander, bishop's weed

Queen Anne's Lace

Dill

Coriander

Attractive Flowers

Good plants to use:

Sunflower Family (Asteraceae)

- coreopsis, Gloriosa daisy, yarrow, cosmos, sunflower, marigolds

Gloriosa Daisy

Yarrow

Cosmos

Attractive Flowers

Good plants to use:

Mustard Family (Brassicaceae)

- Sweet alyssum, twinpod, whitlow grass, sweet rocket, wall flower, rock cress

Twinpod

Sweet Alyssum

Sweet Rocket

Using Plants in the Field or Landscape

Tactics:

- Companion planting
- Strip cropping
- Intercropping
- Cover crops
- Shelterbelts/hedgerows
- Permanent border

Bloom calendar

Common Name	Genus/sp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Willow	*Salix spp.*								
CA lilac	*Ceanothus spp.*								
Coffeeberry	*Rhamnus californica*								
Yarrow	*Achillea millefolium*								
Silverlace Vine	*Polygonum aubertii*								

Plant according to blooming succession

Caveats to Preservation and Enhancement

- Can be difficult/expensive to implement on a large scale.

- Some “beneficial” plantings can increase pest arthropods.

- Not proven to work in all systems.

- Eliminating/reducing use of broad-spectrum insecticides may result in production loss.

- Must take valuable land out of production for attractive plants.

Identifying the good bugs!

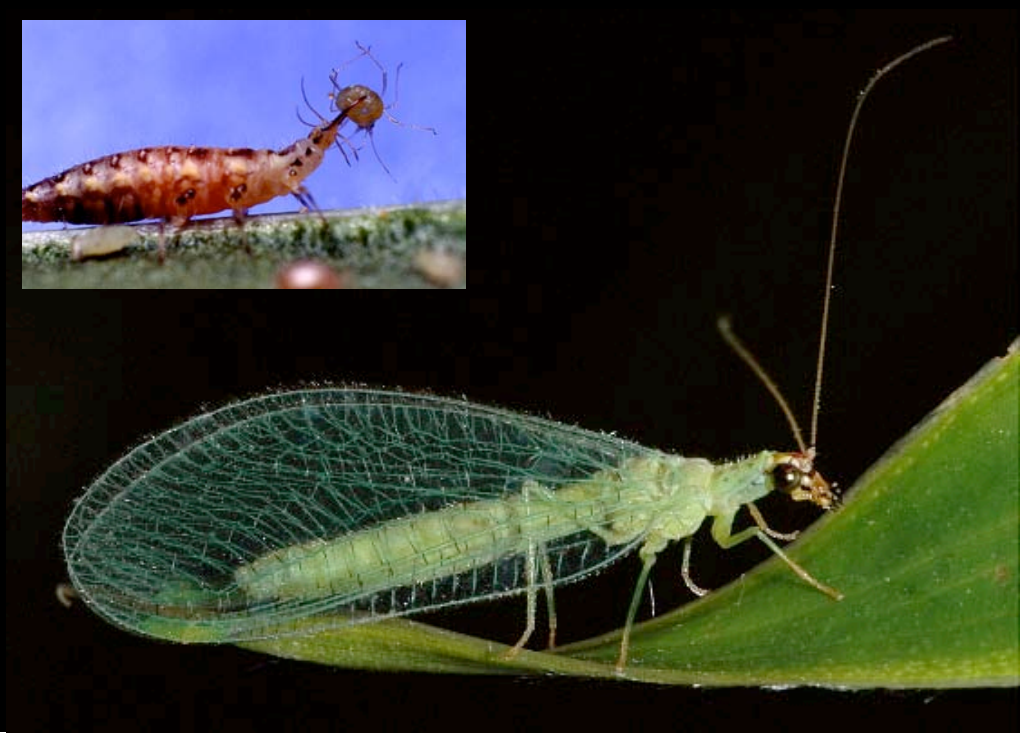
Lacewings: *Chrysopidae and Embiodiidae*

Lacewings: *Chrysopidae and Embiodiidae*

Prey upon
- aphid
- thrips
- mealybug
- scale
- caterpillar
- mite

Plants to attract and conserve
- Carrot family
- sunflower family
- buckwheat
- holly leaf cherry
- corn

*provide water during dry spells



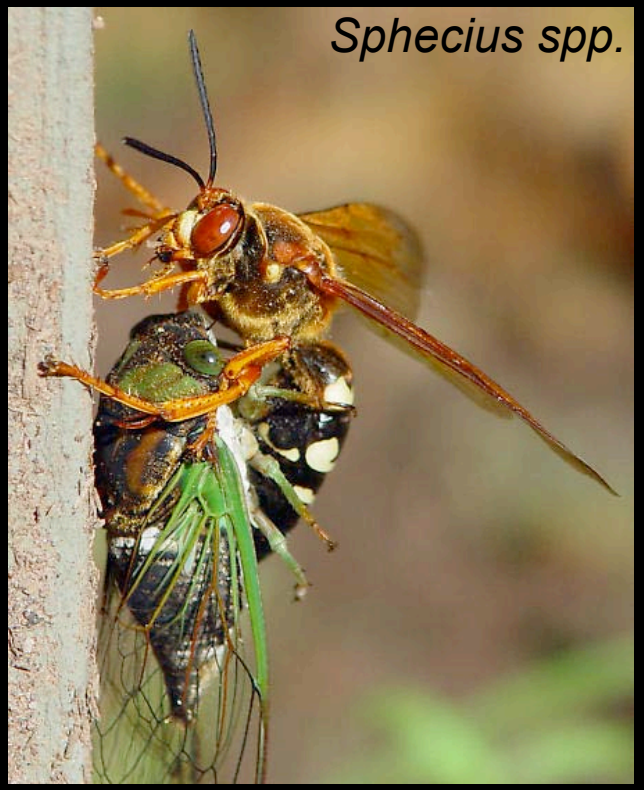
Parasitoid Wasps: *Aphidius spp.* (Braconidae)

Preys upon
- aphid
- armyworm
- cabbageworm
- codling moth
- beetle larvae
- flies
- caterpillars
- etc.

Plants to attract and conserve
- nectar plants w/ small flowers
- caraway
- dill
- parsley
- fennel
- Queen Anne's lace
- white clover
- mustard
- tansy
- yarrow
- sunflower
- hairy vetch
- buckwheat
- cowpea
- common knotweed
- crocuses
- spearmint

Other Wasps: Ichneumonidae

Other Wasps: *Bembix*, *Sphecius*



Other Wasps: *Pompillidae*

Ladybird Beetles: Coccinellidae

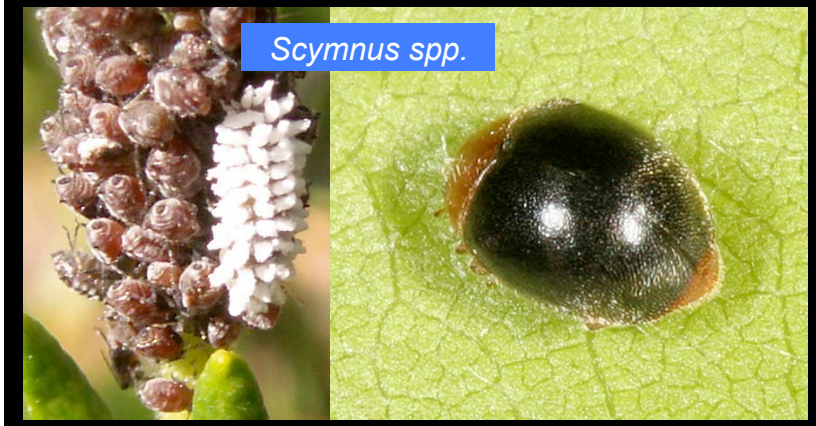
Plants to attract and conserve

- nectar plants w/ small flowers
- caraway
- dill
- parsley
- fennel
- Queen Anne's lace
- white clover
- angelica
- goldenrod
- mustard
- tansy
- yarrow
- sunflower
- hairy vetch
- buckwheat
- cowpea
- common knotweed
- native grasses
- spearmint
- crocuses
- buckthorn
- grains
- saltbush
- black locust

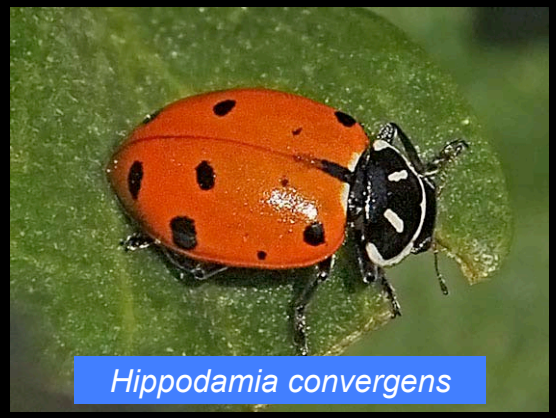
Prey upon

- aphid
- mealybug
- spider mite
- soft scales

Ladybird Beetles: Coccinellidae


Scymnus spp.


Hippodamia parenthesis


Hippodamia convergens

Axion plagiatum


Chilocorus bipustulatus

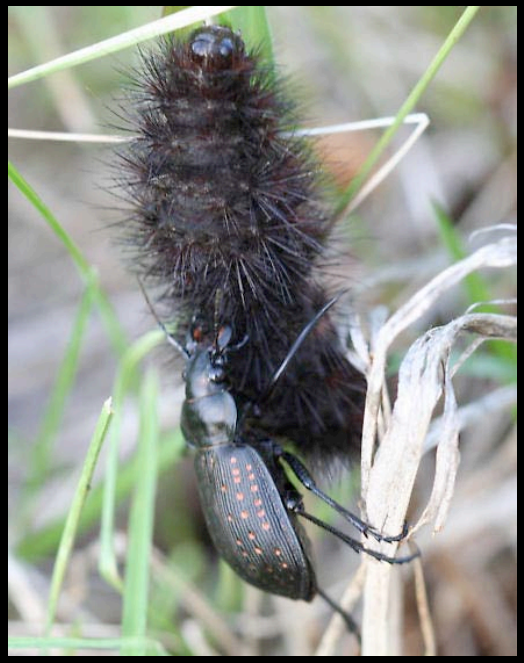

Harmonia axyridis


Coccinella novemnotata

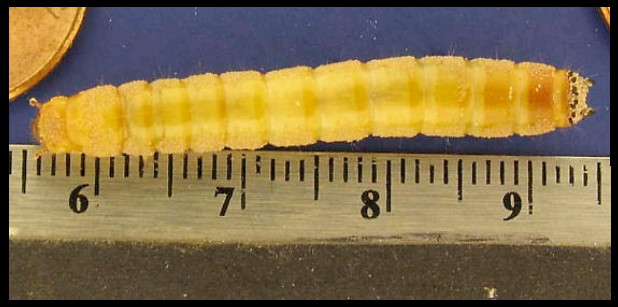
PEST SPECIES


Epilachna varivestis

Predaceous Ground Beetles: Carabidae, Tenebrionidae

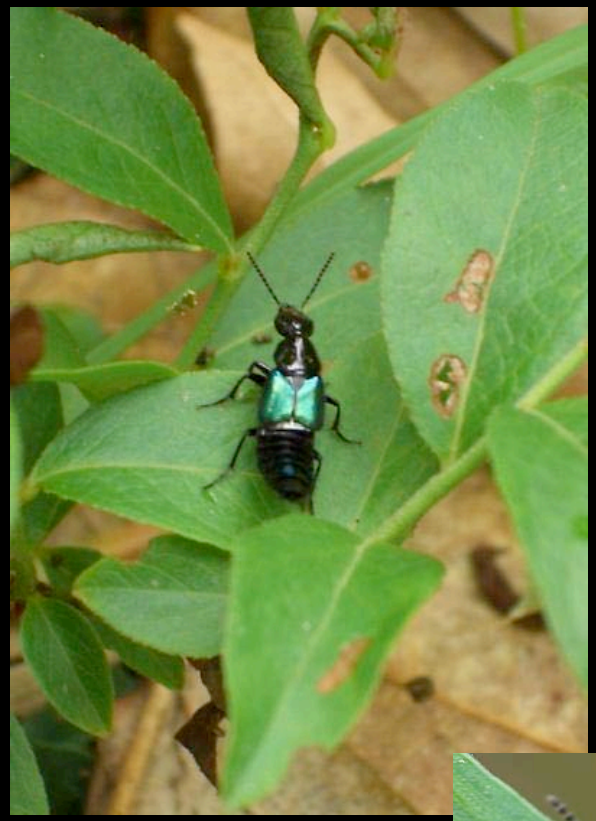


Prey upon
- slug
- snail
- cutrworm
- tent caterpillar
- cabbage-root maggot
- Colorado potato beetle
- gypsy moth



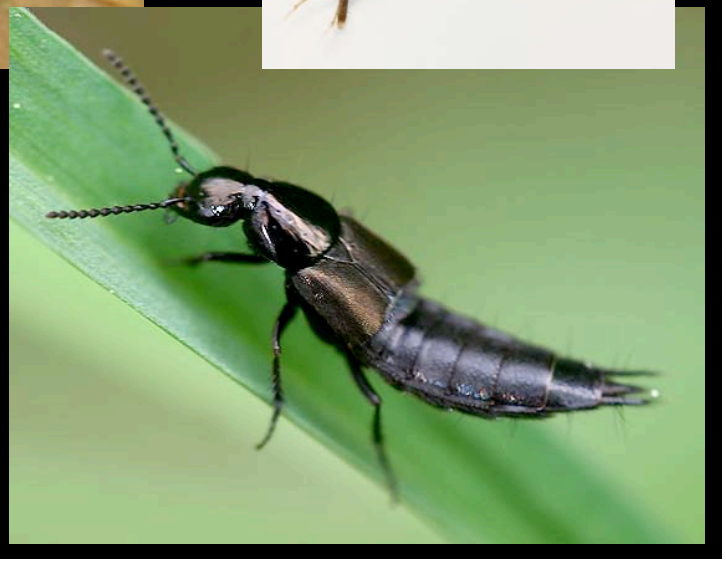
Plants to attract and conserve
- permanent plantings
- amaranth
- white clover
- mulch

Predaceous Ground Beetles: Cantharidae, Staphylinidae



Prey upon

- aphid
- springtail
- nematode
- flies
- some are parasites of cabbage-root maggot



Plants to attract and conserve

- permanent plantings
- stone or plant pathways
- rye
- grains
- mulch

Predaceous Ground Beetles: Cicindelinae

Prey upon
- many things

Plants to attract and conserve
- permanent plantings
- exposed dirt or sand areas

Predaceous True Bugs: Anthochoridae: *Orius spp.,* Lygaeidae: Geocorinae

Prey upon

- thrips
- spider mite
- many others
- leafhopper
- caterpillars

Plants to attract and conserve

- Queen Anne's lace
- coriander
- chervil
- tidy tips
- daisies
- baby-blue-eyes
- alfalfa
- crimson clover
- willows
- tansy
- bishop's weed
- cosmos
- goldenrod
- yarrow
- hairy vetch
- corn
- buckwheat
- shrubs (permanent)

Predaceous True Bugs: Anthochoridae: *Orius spp.,* Lygaeidae: Geocorinae

Plants to attract and conserve

- cool season cover crops
- berseem clover (Trifolium alexandrium)
- subterranean clovers (Trifolium subterraneum)
- common knotweed (Polygonum aviculare)

Prey upon

- true bugs
- flea beetles
- spider mites
- insect eggs
- small caterpillars
- seeds

Predaceous True Bugs: Nabidae, Pentatomidae

Prey upon
- aphid
- thrips
- leafhopper
- treehopper
- small caterpillars

Plants to attract and conserve
- anything in the sunflower family
- goldenrod
- yarrow
- alfalfa

Predaceous True Bugs: Pentatomidae

Prey upon
- fall armyworm
- sawfly
- Colorado potato beetle
- Mexican bean beetle

Plants to attract and conserve
- sunflower family
- goldenrod
- yarrow
- bishop's weed
- permanent plantings

Predaceous True Bugs: Reduviidae

Prey upon
- flies
- tomato hornworms
- many insects
- caterpillars

Plants to attract and conserve
- permanent plantings (hedgrows)

Predaceous True Bugs: Phymatidae

Prey upon
- flies
- tomato hornworms
- many insects
- caterpillars

Plants to attract and conserve
- permanent plantings (hedgrows)
- late-summer/fall-flowering plants

Predatory Flies: Syrphidae

Prey upon
- aphids

Plants to attract and conserve

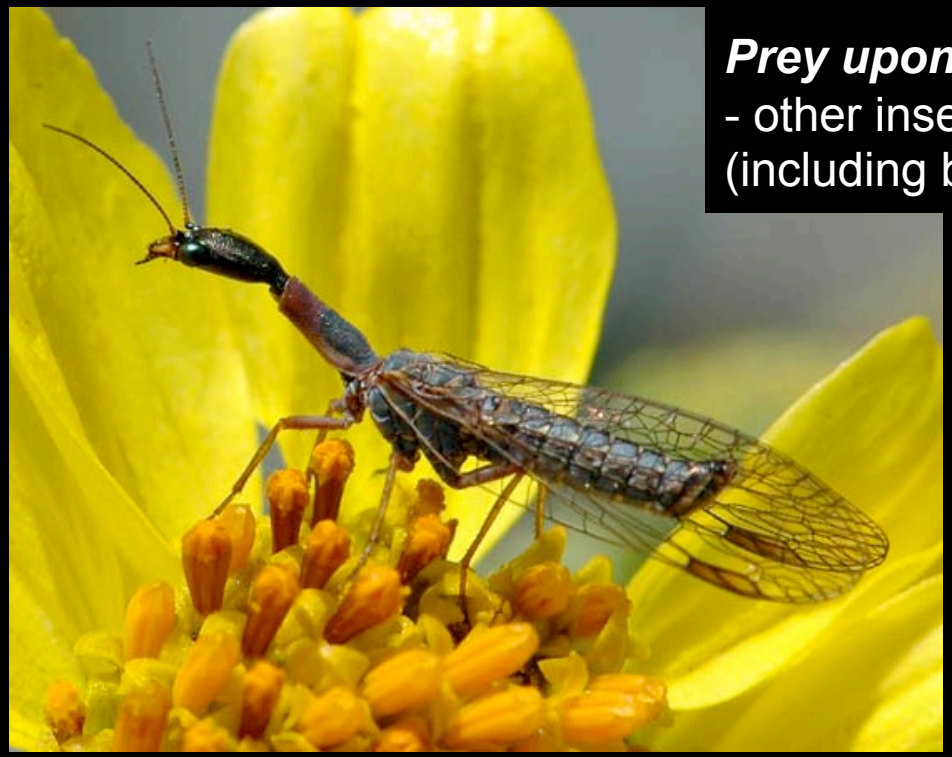
- Queen Anne's lace
- fennel
- tansey
- coriander
- coreopsis
- yarrow
- sunflower
- candytuft
- ceanothus
- buckwheat
- spearmint
- knotweed
- soapbark tree
- baby-blue-eyes
- dill
- caraway
- parsley
- bishop's weed
- Gloriosa daisy
- cosmos
- marigolds
- sweet alyssum
- holly-leaved cherry
- scabiosa
- coyote brush
- California lilacs
- meadow foam

Predatory Flies: Asilidae

Prey upon
- other insects

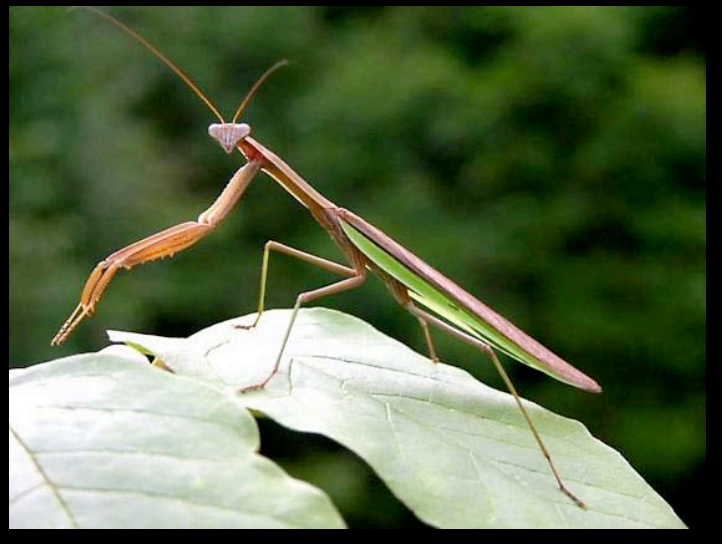
Plants to attract and conserve
- permanent hedgerow

Predatory Neuropterans: Raphidiidae, Mantispidae, Mantidae



Prey upon
- other insects
(including beneficials)

Plants to attract and conserve
- cosmos
- brambles
- permanent plantings



Predatory Thrips

Prey upon
- spider mite
- aphid
- various moths
- alfalfa weevil
- whitefly
- leafminer
- scale

Plants to attract and conserve
- need low populations of other mites, scales, aphids, moth eggs, leafhoppers and other thrips to maintain populations

Predatory Mites: Phytoseiidae

Plants to attract and conserve
need low populations of prey to keep beneficials alive.

Prey upon
- spider mite
- thrips
- small insects
- insect eggs

Spiders

Summary

- Use cultural and mechanical control methods first
  - Prevention
  - Promote diversity and plant health
  - Encourage natural enemies using multiple tactics
  - Monitor/scout
- Apply reduced risk pesticides second
  - Slower acting, may need multiple applications
- Use traditional pesticides sparingly

Thank you!

Ryan Davis

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IPM Concept

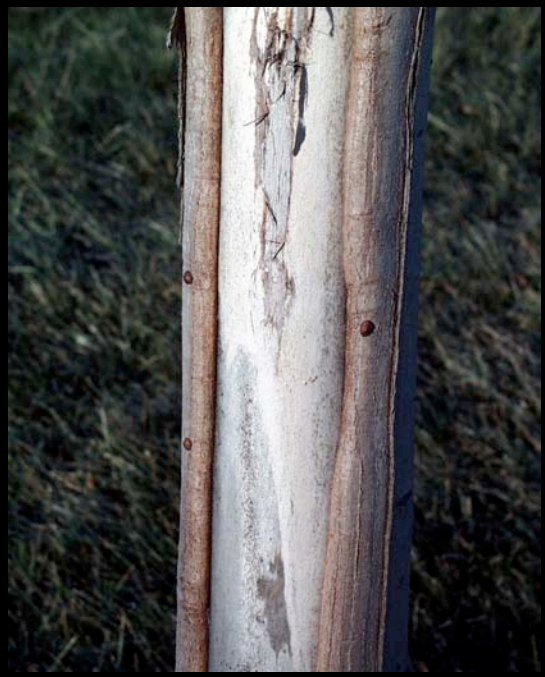
- Integrated pest management
  - Promote plant and ecosystem health by limiting chemical applications
  - Plan ahead with regular scouting/monitoring
  - Use thresholds (economic or aesthetic)
  - Multiple tactics based on insect and host biology to reduce pests

IPM tactics to reduce the need for pesticides

- Cultural
- Mechanical

Cultural Control

- Seek resistant/tolerant plants
- Avoid susceptible plants
- Start out with pest-free plants
- Plan ahead, diversify plant selection; plant for good bugs
- Rotate crops
- Plant properly
- Keep plants healthy



Mechanical/Physical Control

- Barriers, screens
- Traps, bands
- Mulch
- Tillage
- Sanitation
- Hand removal


IRAC
Insecticide Resistance Action Committee
Select a group to open...
Select a c
1 - Acetylcholine esterase inhibitor
Subgroup: A
Chemical Class: Carbamates
Aldicarb
Alanycarb
Bendiocarb
Benfuracarb
Butocarboxim
Butoxycarboxim
Carbaryl
Carbofuran
Carbosulfan
Ethiofencarb

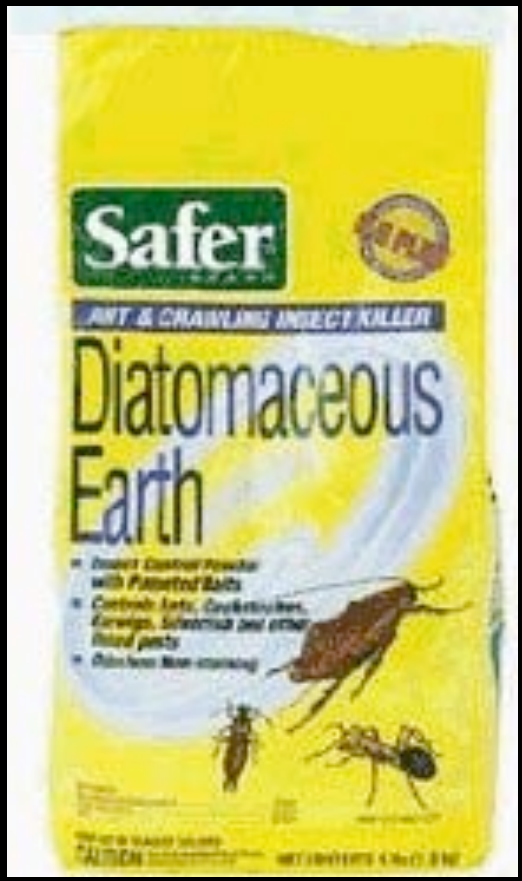
Chemical control

Main Groups	Sub-Groups
1	Carbamates/ Organophosphates
2	Cyclodiene/organochlorines Phenylpyrazoles (Fiproles)
3	Pyrethroids/pyrethrins DDT/Methoxychlor
4	Neonicotinoids/Nicotine
5	Spinosyns
6	Avermectins/Milbemycins
7	Juvenile hormone analogues Fenoxycarb/pyrproxyfen
8	Methyl bromide/Chloropicrin/ Sulfuryl fluoride/borax/tartar emetic
9	Pymetrozine/Flonicamid
10	Clofentezine/Hexythiazox Etoxazole
11	*Bacillus thuringiensis*
12	Diafenthiuron/organotin miticides/Propargite/tetradifon
13	Chlorfenapyr

Main Groups	Sub-Groups
14	Nereistoxin analogues
15	Benzoylureas
16	Buprofezin
17	Cyromazine
18	Diacylhydrazines
19	Amitraz
20	Hydramethylnon/ Acequinocyl/Fluacrypyrim
21	METI acaracides/ Rotenone
22	Indoxacarb/ metaflumizone
23	Tetronic and tetramic acid derivatives
24	Phospine/Cyanide
25	Vacant
26	Vacant
27	Vacant
28	Diamides

Suffocants, Desiccants, Membrane Disruptors

Soaps, oils, sucrose esters, dusts, DE



Microbials

- Targeted host selection
- Kill, reduce reproduction, or shorten the life
- Environment controls effectiveness
- Relatively slow acting; may take several days and repeated applications

fungus


nematode


virus

Eating Disruptor

Kaolin clay (Surround®)

– Physical barrier, excessive grooming

Botanicals (aka plant derived)

- Neem (neem trees)
  - Trilogy®
- Pyrethrum (pyrethrum daisy)
  - Pyganic®, Evergreen®
- Rotenone (subtropical leguminous shrubs)
  - Pyrellin®