

Lecture 2:

Biological Control

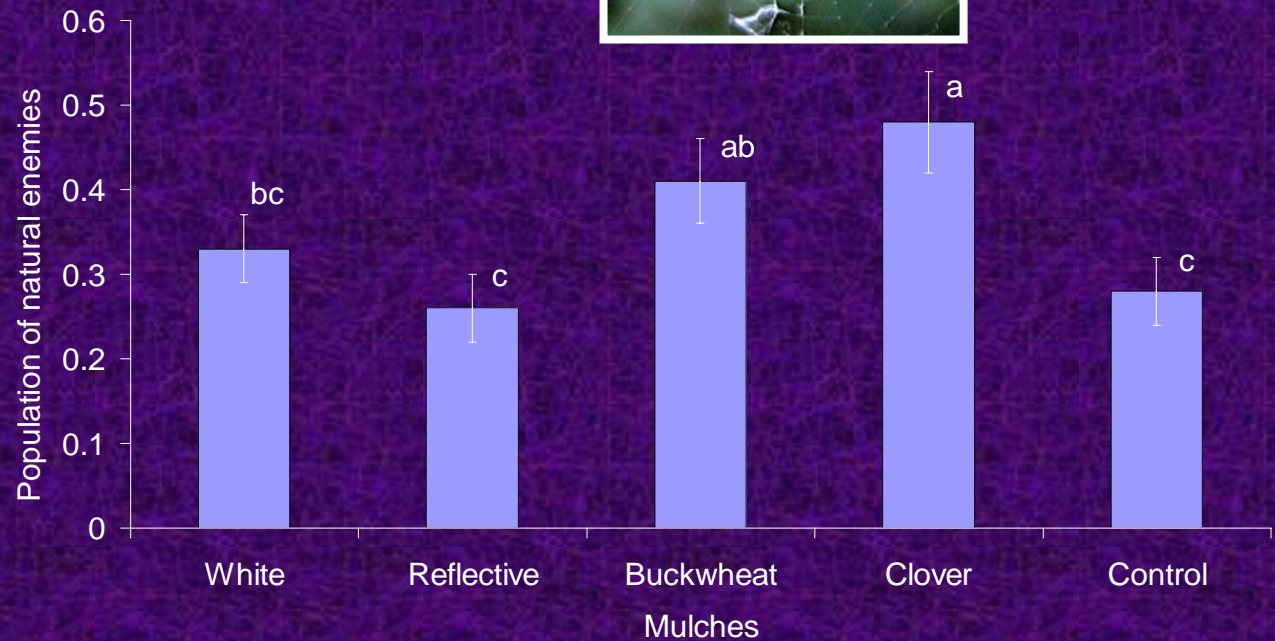
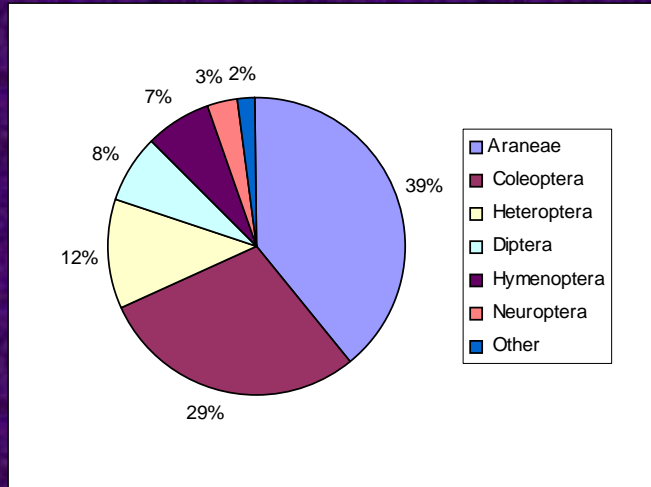
- ❖ Biological control is one of the oldest methods of insect control.
- ❖ Biological control is defined as any activity of one species that reduces the adverse effect of another.
- ❖ The agents for biological control are living natural enemies.
- ❖ Natural control involves the regulation of pest populations with natural enemies and environmental factors including temperature, moisture and wind velocity. No deliberate manipulation is involved.

Biological Control

➤ It became established in the US around 1888

Cottony cushion scale, *Icerya purchasi* Maskell was threatening citrus industry in southern California in 1885. C.V. Riley (Chief entomologist for US) arranged a trip to Australia. Albert Koebele an American entomologist subsequently traveled to Australia and brought back to the US a parasitic fly and the vedalia beetle *Rodolia cardinalis* (Mulsant). They both became established and cottony cushion scale was brought under control by 1889.

Population of natural enemies in cucurbits treated with different mulches (2003)



Predators

- Predator - Any organism that attack and feed on other animals (prey) and consumes more than one animal during its lifetime

They are generally two feeding types:

- Specialist
- Generalist

Predatory Mites

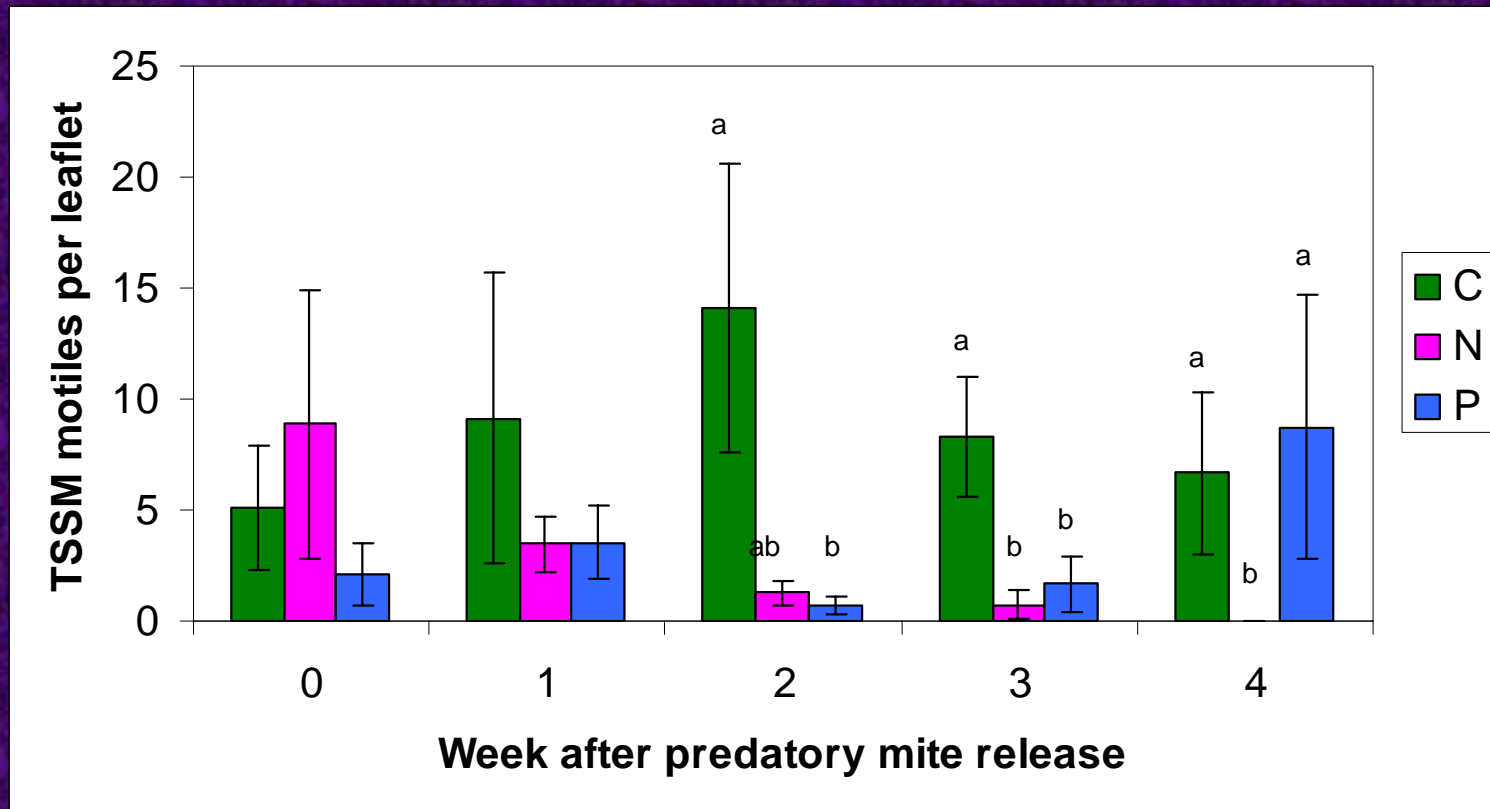


Pytoseiulus persimilis

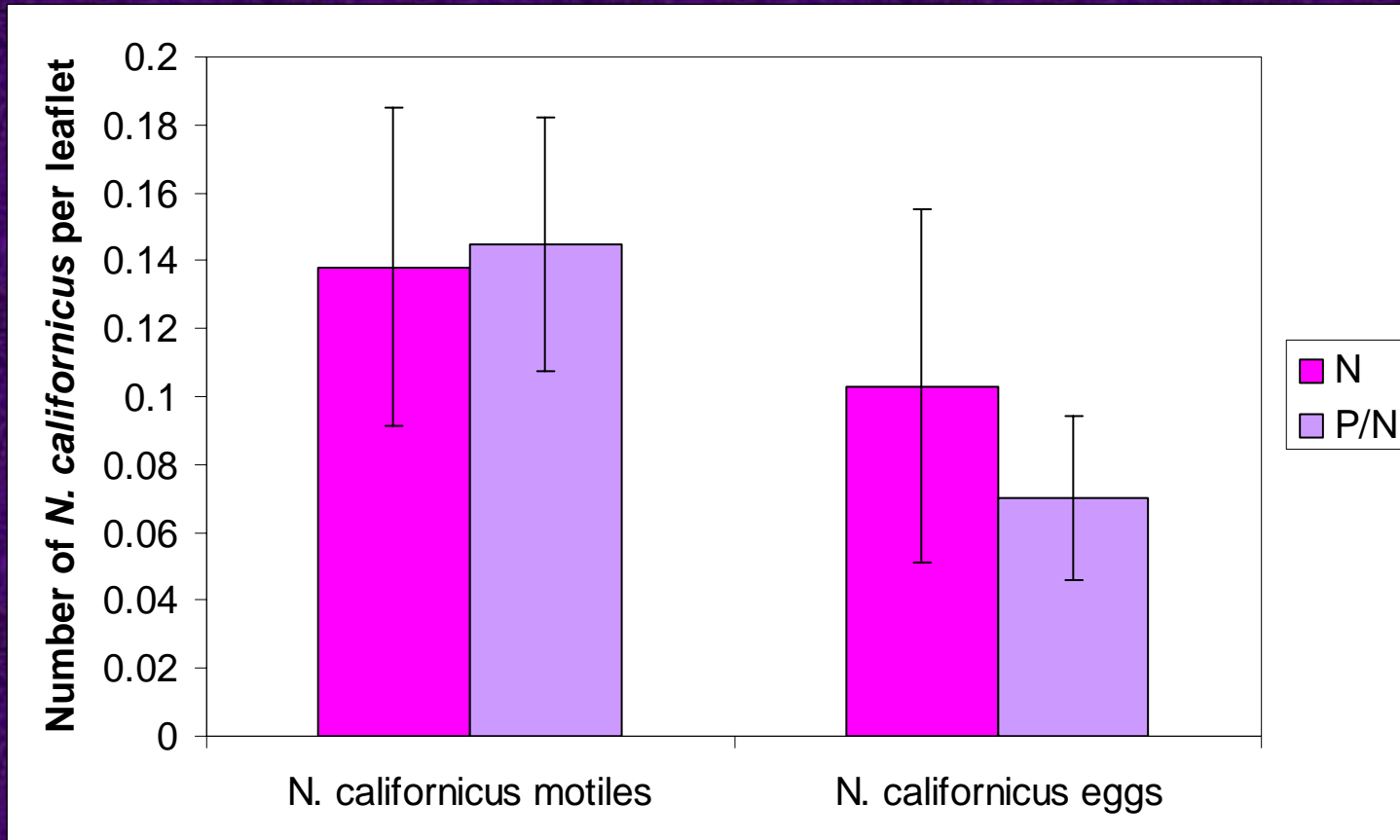


Neoseiulus californicus

Average TSSM motiles per leaflet in strawberries



Average *N. californicus* per leaflet in strawberries
N. californicus vs. *P. persimilis*/*N. californicus* treatments



for motiles, $t = 0.11$, $df = 866$, $p = 0.4563$

for eggs, $t = -0.57$, $df = 643$, $p = 0.2837$

Insect Orders with Predatory Significance

Coleoptera

- Coccinellidae; lady beetles



- Carabidae; ground beetles



aphids
scale insects
spider mites

Insect Orders with Predatory Significance

Hemiptera

Lygaeidae



Bigeyed bug, *Geocoris* spp.

Anthocoridae



Minute pirate bug, *Orius* spp.

Nabidae

Damsel bug, *Nabis*



aphids
caterpillars

Insect Orders with Predatory Significance

Diptera

Syrphidae; Flower flies

Larvae feed on aphids



Neuroptera: Chrysopidae

Green lacewings



aphids
scale insects
thrips

Non-arthropod Predators

Birds, fish amphibians (toads, frogs, salamanders), reptiles (lizards, snakes, turtles), mammals (bats, rodents)

Feeding categories

- ❖ Monophagous - feeding on a single species.
- ❖ Oligophagous - feeding on a selected narrow host range.
- ❖ Polyphagous - feeding on a wide range of prey.

Parasitoid

- ❖ Parasitoid- an insect usually a wasp that develops within the body of another insect
- They are parasitic in their immature stages and free living as adults.
- They generally have a narrow host range
- Only one host is required for complete development
- Populations can be sustained at low host levels
- Host can live for a long time
- They always kill their host.

Common parasitoids used in fruit & vegetable IPM

Hymenoptera

Aphelinidae



Encarsia formosa

Braconidae



Cotesia plutella



Braconidae

Diachasma alloeum

Parasite

- ❖ Parasite – is an animal that lives on or within a larger animal (host)
 - Requires one or a few host in its lifetime
 - A parasite rarely kills its host
- ❖ Primary parasite - refers to the original parasite of the pest.
- ❖ Hyperparasite - a parasite that feeds on another parasite.
Encarsia pergandiella and *E. tricolor* are hyperparasites of *E. formosa*.
- ❖ Secondary parasite – a parasite feeding on a primary parasite (hyperparasite).

Insect parasitic nematodes

- ❖ Nematodes are thin, un-segmented round-worms, which are parasitic on plants and other animals, or are free-living in soil or living water

Important families in the class Nematoda

Steinernematidae - *Steinernema carpocapsae* - beetle grubs

Heterorhabditidae - *Heterorhabditis bacteriophora* - maggots

Mermithidae - *Romanomermis culicivorax* – mosquitoes

They are used mostly as a bio-pesticides in high and medium value crops including cole crops, berry crops and turfgrass for control of borers, root maggots and cutworms

Strategies for Biological Control

- **Introduction** - referred to as ‘classical biological control’
It involves the deliberate introduction and establishment of natural enemies into areas where they did not previously exist
- **Conservation and Enhancement** - Activities designed to improve survival, dispersal and reproduction of native natural enemies
- **Augmentation** - Any biological control activity designed to increase the population of natural enemies

Steps in Classical Biological Control

- Identification of the pest and its native area
- Conduct survey for natural enemies in pest native area
- Shipment of species to quarantine facility in the area where natural enemies will be released
- Host evaluation studies in quarantine facility
- Special permit for releasing in specific areas for further evaluation
- If successful, final release

Conservation and Enhancement Practices

- ✓ The use of selective insecticides to avoid natural enemy mortality
- ✓ Increasing plant diversity
- ✓ Providing resources including food, overwintering sites water
- ✓ Strip harvesting

Techniques to augment natural enemy populations

- **Inundative releases** - The release of large quantities of natural enemies with little or no impact expected from their progeny (several applications).
 - ✓ *Trichogramma* spp.- egg parasitoid; European corn borer
 - ✓ Green lacewings; *Chrysoperla carnea*
 - ✓ Ladybird beetles, *Hippodamia convergens*
- **Inoculative releases** - The release of natural enemies with the expectation that they will reproduce and spread throughout the area.
 - ✓ Greenhouse pests – *Encarsia formosa*
Pytoselius persimilis

Biological Insecticides for IPM Programs

- *Bacillus thuringiensis* (Bt) is the most widely used biological control agent in the US.

Common Bt strains

- *kurstaki*, *aizawai* and *morrisoni* used against lepidoptera larvae in crops
 - *israelensis* for mosquito control
 - *tenebrionis* for control of beetles (Colorado potato beetle)
- Spinosad- a natural product of the bacterium *Saccharopolyspora spinosa*

Several formulations: SpinTor, Success

Biological Insecticides for IPM Programs

Avermectin – is a natural control agent from the species *Streptomyces avermitilis*. It is registered for control of mites and leafminers.

Abamectin

Ivermectin