INTEGRATIVE PEST MANAGEMENT PART 1

Michael Rocky Trevizo

The biggest enemy of an insect is another INSECT!!

Bio-control is the use of a pest insect's natural insect enemies for its control.

Bugs eat Bugs

1) As direct **predators**

2) As **parasites** & **parasitoids**

BIBLICAL TEXTS ABOUT PEST, CROPS & SOILS

- He spake, and the locusts came, and caterpillers, and that without number, And did eat up all the herbs in their land, and devoured the fruit of their ground.

  KJV — Psalm 105:34-35

BIBLICAL TEXTS ABOUT PEST, CROPS & SOILS

- If I shut up heaven that there be no rain, or if I command the locusts to devour the land, or if I send pestilence among my people; If my people, which are called by my name, shall humble themselves, and pray, and seek my face, and turn from their wicked ways; then will I hear from heaven, and will forgive their sin, and will heal their land.

  KJV — 2Chronicles 7:13-14

UNTO THE EGYPTIANS

- But he, being full of compassion, forgave their iniquity, and destroyed them not: yea, many a time turned he his anger away, and did not stir up all his wrath. For he remembered that they were but flesh; a wind that passeth away, and cometh not again. How oft did they provoke him in the wilderness, and grieve him in the desert! Yea, they turned back and tempted God, and limited the Holy One of Israel. They remembered not his hand, nor the day when he delivered them from the enemy. How he had wrought his signs in Egypt, and his wonders in the field of Zoan: And had turned their rivers into blood; and their floods, that they could not drink. He sent divers sorts of flies among them, which devoured them; and frogs, which destroyed them. He gave also their increase unto the caterpiller, and their labour unto the locust. He destroyed their vines with hail, and their sycomore trees with frost. He gave up their cattle also to the hail, and their flocks to hot thunderbolts. He cast upon them the fierceness of his anger, wrath, and indignation, and trouble, by sending evil angels among them. He made a way to his anger; he spared not their soul from death, but gave their life over to the pestilence; And smote all the firstborn in Egypt; the chief of their strength in the tabernacles of Ham: KJV — Psalm 78:38-51

RETURNING UNTO GOD

- I have smitten you with blasting and mildew: when your gardens and your vineyards and your fig trees and your olive trees increased, the palmerworm devoured them: yet have ye not returned unto me, saith the LORD. KJV — Amos 4:9

RETURNING UNTO GOD

- Will a man rob God? Yet ye have robbed me. But ye say, Wherein have we robbed thee? In tithes and offerings. Ye are cursed with a curse: for ye have robbed me, even this whole nation. Bring ye all the tithes into the storehouse, that there may be meat in mine house, and prove me now herewith, saith the LORD of hosts, if I will not open you the windows of heaven, and pour you out a blessing, that there shall not be room enough to receive it. *And I will rebuke the devourer for your sakes*, and he shall *not destroy the fruits* of your ground; neither shall your vine cast her fruit before the time in the field, saith the LORD of hosts. And all nations shall call you blessed: for ye shall be a delightsome land, saith the LORD of hosts.

  KJV — Malachi 3:8-12

GODS PROMISE

- And I will restore to you the years that the locust hath eaten, the cankerworm, and the caterpillar, and the palmerworm, ***my great army which I sent among you***. And ye shall eat in plenty, and be satisfied, and praise the name of the LORD your God, that hath dealt wondrously with you: and my people shall never be ashamed.

  KJV — Joel 2:25-26

PROMISE MADE AT THE TEMPLE COMMISSIONING

- If there be in the land famine, if there be pestilence, blasting, mildew, locust, or if there be caterpiller; if their enemy besiege them in the land of their cities; whatsoever plague, whatsoever sickness there be; What prayer and supplication soever be made by any man, or by all thy people Israel, which shall know every man the plague of his own heart, and spread forth his hands toward this house: Then hear thou in heaven thy dwelling place, and forgive, and do, and give to every man according to his ways, whose heart thou knowest; (for thou, even thou only, knowest the hearts of all the children of men;) That they may fear thee all the days that they live in the land which thou gavest unto our fathers.

  KJV — 1Kings 8:37-40

The biggest enemy of an insect is another INSECT!!

Bio-control is the use of a pest insect's natural insect enemies for its control.

Bugs eat Bugs

1) As direct **predators**

2) As **parasites** & **parasitoids**

Predators: exist by preying upon other organisms

- Usually larger than prey
- Need multiple prey to complete lifecycle


Photo: Scott Bauer, USDA-ARS photo library

Can be Voracious feeders of
- aphids
- scale insects
- mites
- thrips
- white flies
- caterpillars
- beetle larvae
- other soft-bodied insects

Common Predators

Lacewing

Syrphid Fly (Hover Fly)

Ladybird Beetle (Ladybug)

Charismatic Predators…

Watch this video!

Parasite: lives on, or in, a host organism and benefits by deriving nutrients at the host's expense

Parasitoid: same as above, except it ultimately kills (or sterilizes) and sometimes consumes the host

- Usually smaller than prey
- Needs one host organism during lifecycle
- Many are parasitic during the early growing stages and emerge as free-living adults

Common Parasitoids

Hymenoptera (wasps)
Diptera (flies)

HUGE! Tarantula Hawk

Wasp on stinkbug eggs

On plants: "Look familiar? I did that."

Biological Control – Advantages

- Self-perpetuating
- Pest specific
- Density dependent
- Cost effective
- Environmentally compatible

Biological Control – Constraints

- Not immediately effective (may take years)
- Not eradicative (is this really a constraint?)
- Biocontrol agents unknown for many pest species.
- Doesn't always work
  - Historically only one out of four attempts has been successful

What makes an effective biocontrol "agent"??

- High to complete prey specificity
- Multivoltine with respect to target species
- Well adapted to habitat of target species
- Excellent searching ability

Lacewing immature at "lunch"

Classic Biological Control

"Control of an exotic insect pest by the introduction of its natural enemies"

- foreign exploration
- quarantine processing
- mass propagation
- field colonization (release)
- evaluation of impact

100 successes in the past 100 years!!

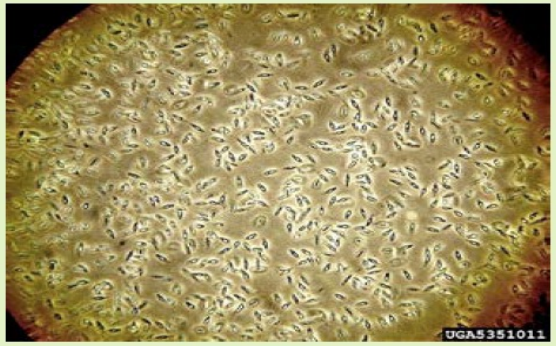
In addition to Classical Biocontrol (bug vs. bug/plant), we also use:

- Insect Pathogens
  - Viruses - Japanese Beetle Milky Disease
    - Nuclear Polyhedrosis Virus
  - Bacteria - the classic *Bacillus thuringiensis*
  - Microsporidians - against grasshoppers
  - Entomopathogenic fungi
  - Entomopathogenic nematodes

Viruses

Milky Spore: *Bacillus popillae*

DIY



Japanese beetle

Nuclear Polyhedrosis Virus (NPV)

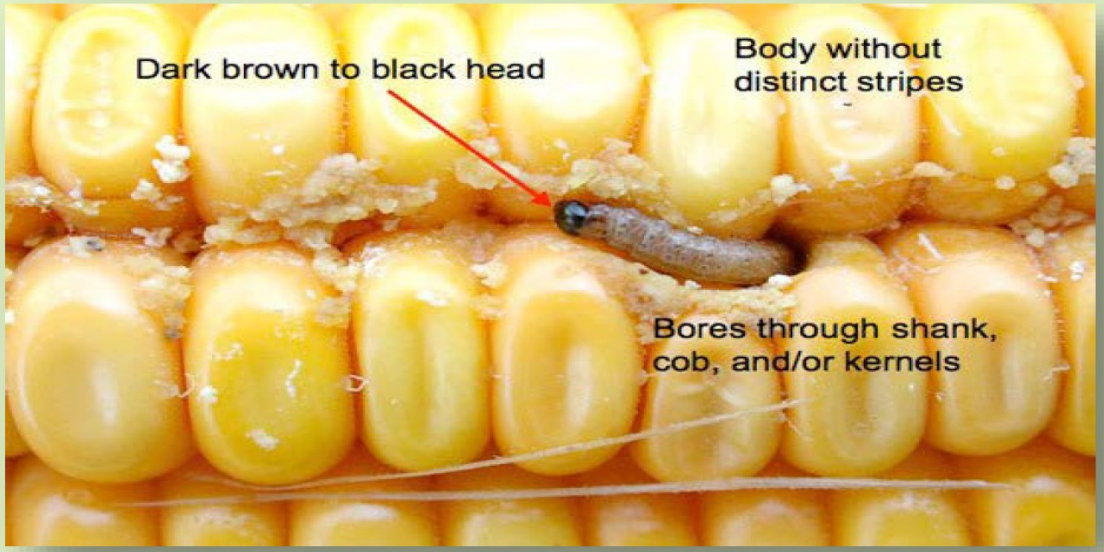
Infects moths & butterflies (like Gypsy Moth)

Bacteria

Bacillus thuringiensis (Bt)

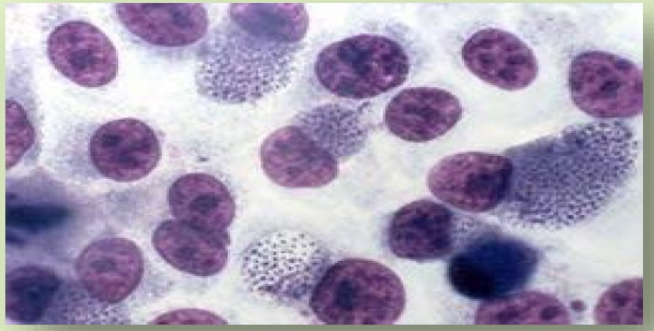
- stomach poison
- insect dies of starvation

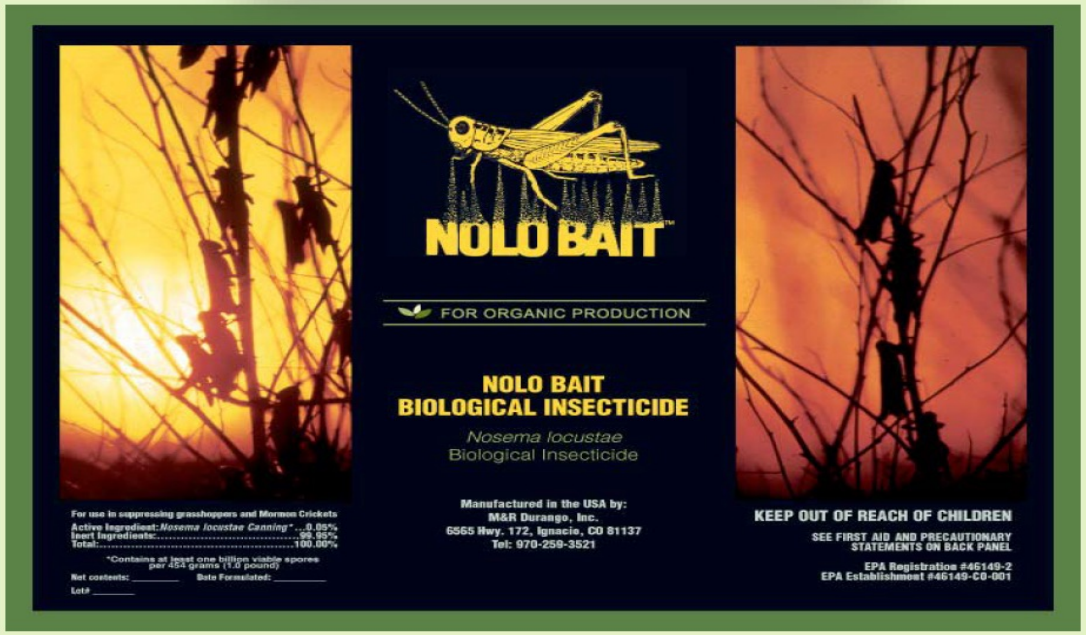
European corn borer



Microsporidians

Nosema locustae



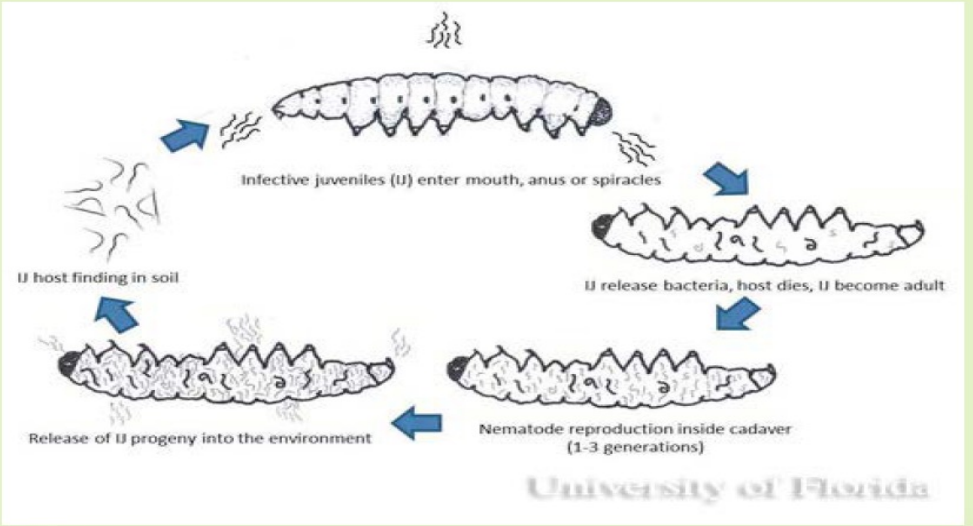


Fungi

Beauveria bassiana

Nematodes

(EPN)



IMPORTANCE OF PROPER NUTRITION CLIMATE AND MOISTURE

- Soil nutrient balancing
- Proper organic matter content
- Appropriate climate for the desired crop
- Proper moisture content in soil/root zone

IMPORTANCE OF PROPER NUTRITION CLIMATE AND MOISTURE

- Soil nutrient balancing
- Proper organic matter content
- Appropriate climate for the desired crop
- Proper moisture content in soil/root zone

IMPORTANCE OF PROPER NUTRITION CLIMATE AND MOISTURE

- Soil nutrient balancing
- Proper organic matter content
- Appropriate climate for the desired crop
- Proper moisture content in soil/root zone

IMPORTANCE OF PROPER NUTRITION CLIMATE AND MOISTURE

- Remember the words of EGW;

  No one can succeed in agriculture or gardening without attention to the laws involved. The special needs of every variety of plant must be studied. Different varieties require different soil and cultivation, and compliance with the laws governing each is the condition of success. ED 111.3

- BY ”different soil and cultivation” implies a variety of soil moisture, nutrients, textures and temperatures.

MAIN FACTS TO KNOW ABOUT I.P.M.

- A scouting program, for best result you must find the pest as early as possible
- Numbers, numbers, numbers
- Application rates per square feet of growing space
- Selection of the right predators/organisms for the target pest
- Insuring the selected organisms will work on the host crop

IMPORTANT MAIN FACTS TO KNOW ABOUT I.P.M.

- Prevention application rates

  VS

- Treatment application rates

- Where can you find these numbers?

INTEGRATIVE PEST MANAGEMENT PART 2

Michael Rocky Trevizo

MAIN FACTS TO KNOW ABOUT I.P.M.

- $$$ MONEY $$$
- You must take an approach that will make financial since
- You must purchase the correct organism for the target pest insect.
- The organisms must be at the right place at the right time; APPLY THEM IMEDIATELY UPON RECEIVING THEM!!!
- Check for predation/incompatibility with other bio's that you are/have applied

PREDATORY MITES

- Amblyseius *swirskii*
- Amblyseius *Andersoni*
- Amblyseius *californicus*
- Amblyseius *cucumeris*
- Phytoseiulus *persimilis*

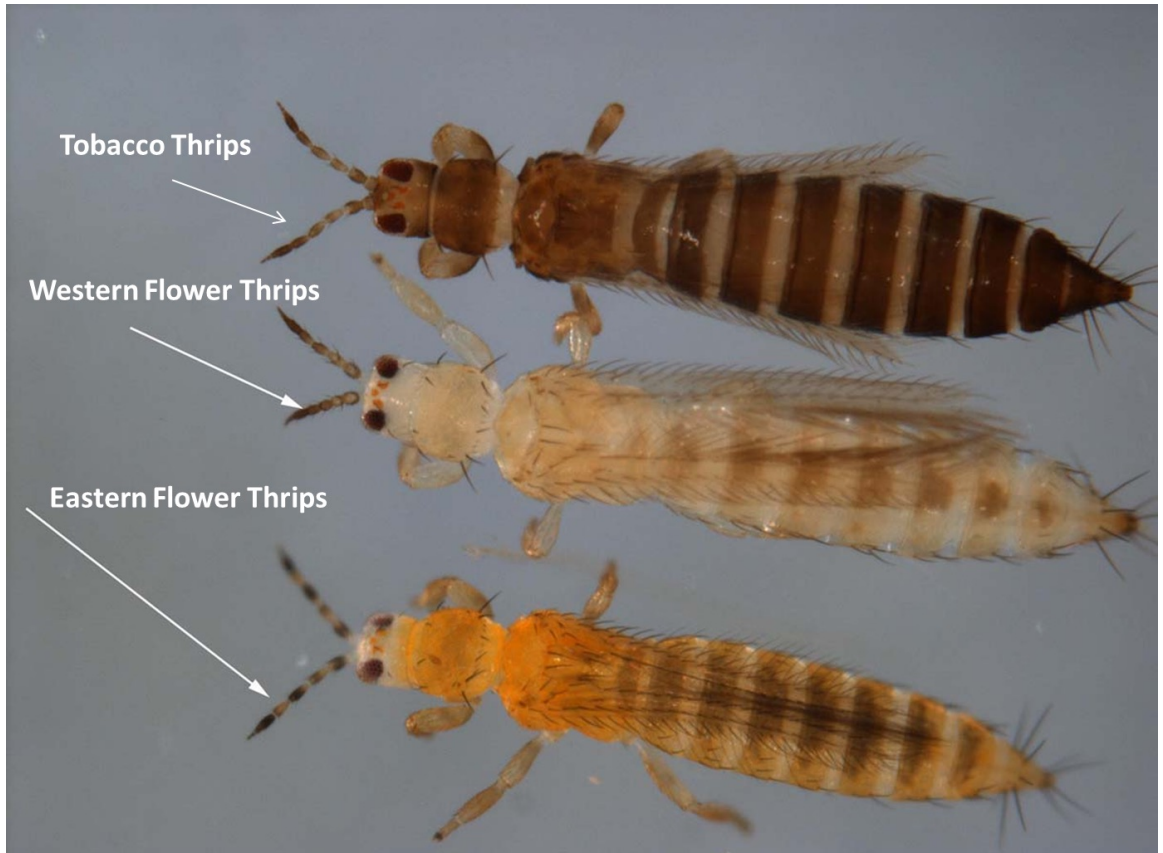
AMBLYSEUIS *SWIRSKII*

- whitefly & thrips predator
- F

- whitefly life cycle takes: **6-10 days for egg hatch**, 3-4 days as a nymph I, 4-5 days as nymph II, 4-5 days as nymph III, 6-10 days for the pupa. Adults can live for 30 to 40 days.

ABLYSEUIS *CUCUMERIS*

- thrips predator



ERECTMOCERUS *EREMICUS & MUNDUS*

- whitefly parasitoid
- Adapted to wormer climates
- Great for greenhouses
- ideal temperatures at 77 F
- **80-250 eggs** laid during 10-16 day life cycle;

  vs Adult female whiteflies which live up to six weeks, and can produce **up to 200 eggs**

ENCARSIA FORMOSA

- Parasitoid best used for prevention, low infestation management and maintenance of greenhouse whitefly.
- *Encarsia formosa* females live for approximately **12 days** and can lay **59 eggs** during this time with *T. vaporariorum* as a host

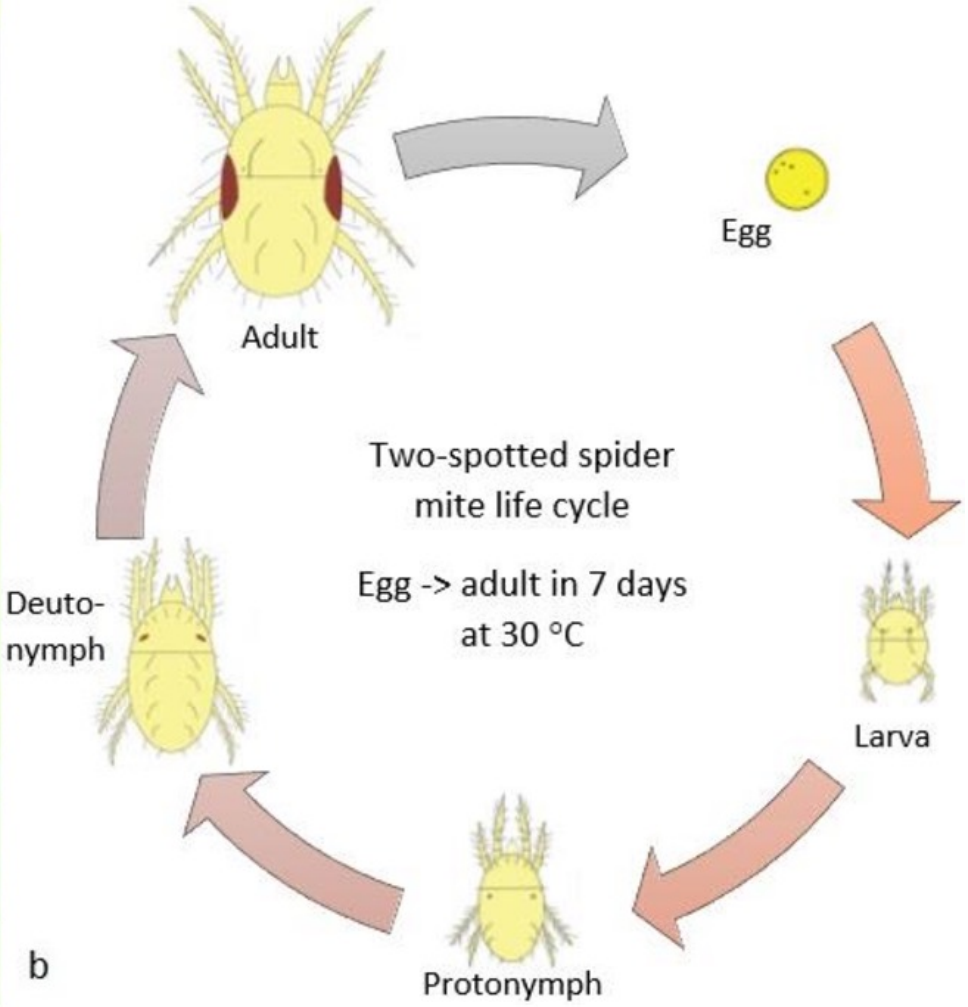
AMBLYSEUIS *ANDERSONI*

- mites predator
- Works even in hotter climates
- Only mite that walks well on tomatoes
- Only mite known to consume russet mites, but only marginally effective
- CAN CONSUME OTHER DESIRALBE MITES INTRODUCED TO CROP SYSTEM

TETRANYCHUS

- **Spider mite larvae, nymphs and adults** feed on the underside of the leaves and cause yellow spots, later even yellow leaves. Plant cells turn yellow, which can be seen on the upper surface of the leaf as small yellow spots. This reduces the photosynthetic area of the leaf and the plant gets out of the physiological balance. This results in decreased plant growth and production. Finally the crop may die from the infestation.
- **Nymphs and adults** produce webbing that can cause cosmetic damage to the crop.
- If large numbers of spider mites are present, plants may be completely covered with webs.
- Life cycle is: 5-40 days from egg to adult avg 7 days

TETRANYCHUS LIFE CYCLE



AMBLYSEUIS *CALIFORNICUS*
AKA NEOSEIULUS CALIFORNICUS

- two spotted spider mites, broad mites, cyclamen mites; and thrips

  consumes 5.3 spidermite eggs per day

- Good for lower spider mite densities as they will survive longer periods with out prey and can survive on plant pollen

- Release rate: 1-2 per plant

PHYTOSEIULUS *PERSIMILIS*

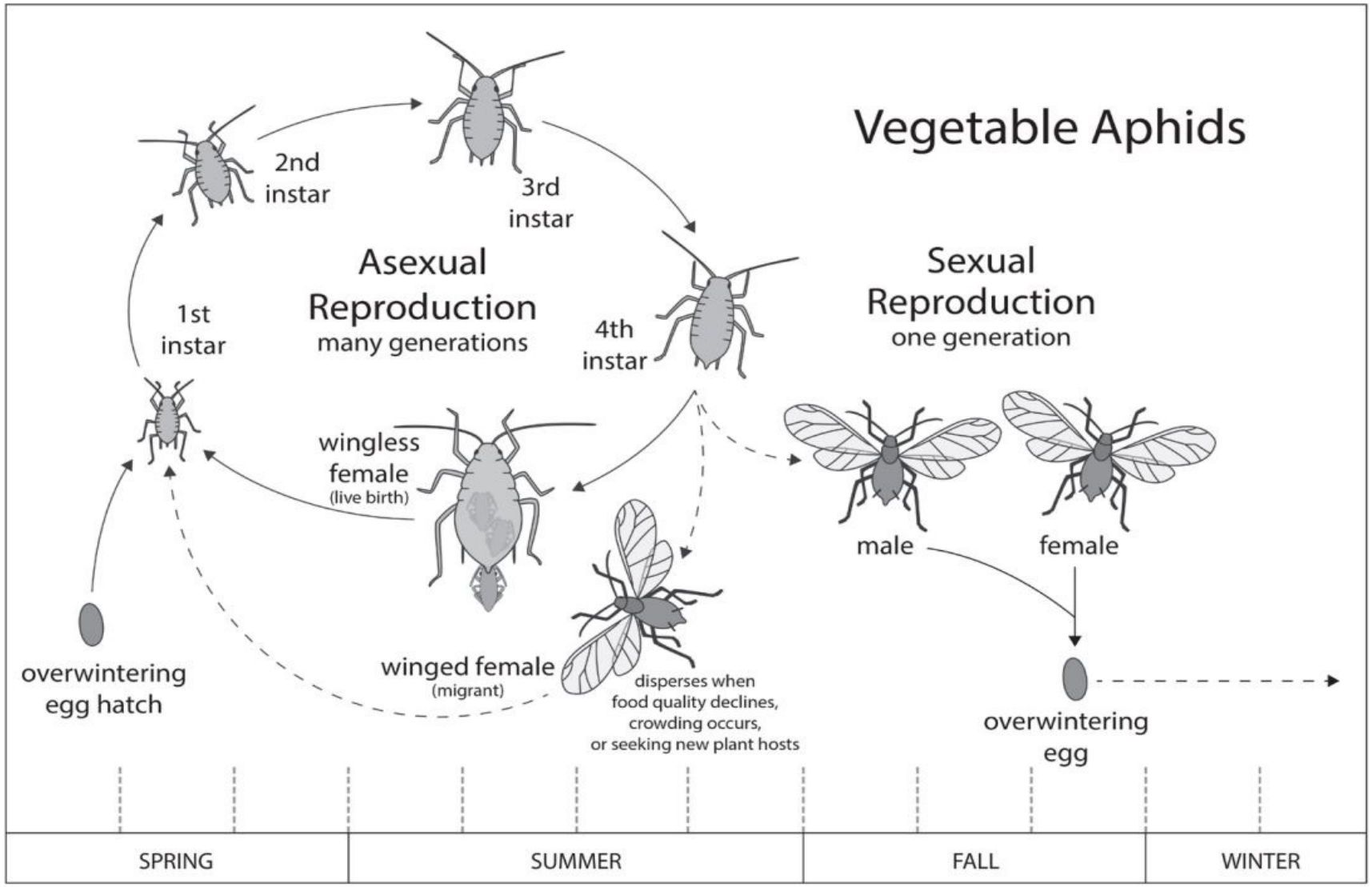
- two-spotted spider mite predator
- Silver bullet of IPM
- HEAVY FEEDER

APHIDOLETES *APHIDIMYZA*

- aphid predator
- Feed mostly in the larve stages
- Pupates in the soil

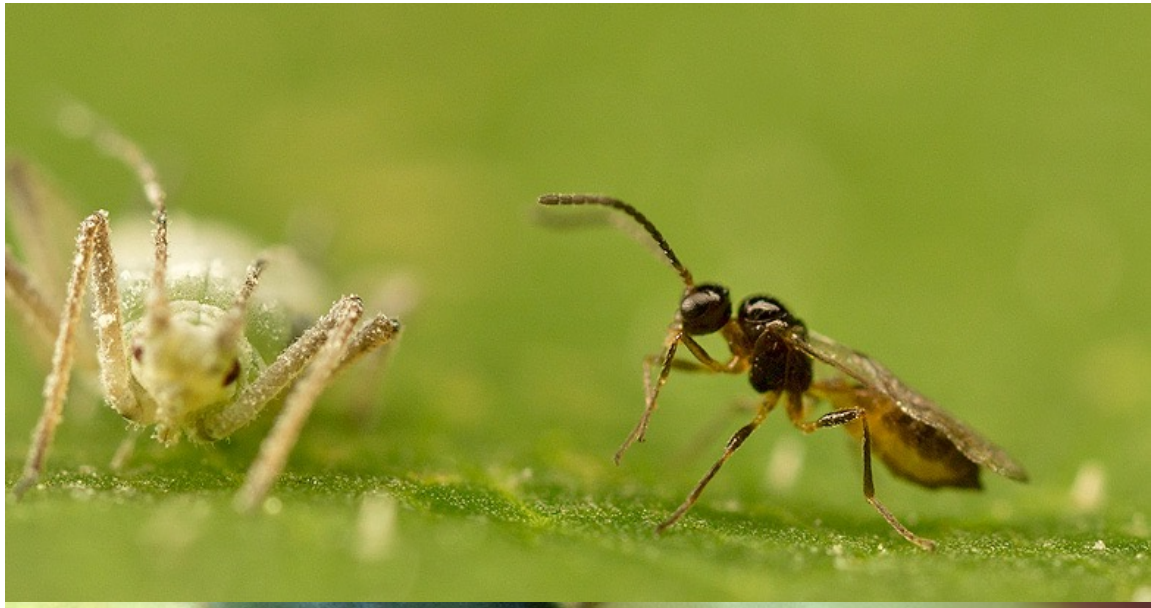
APHID LIFE CYCLE

- 10-30 generations per year
- Reach sexual maturity in 4-10 days
- With 1 month life cycle



APHIDIUS COLEMANI

- aphid parasitoid
- Works best on melon aphids (**Aphis gossypii**)
- Not very effective on potato aphids usally red, pink or green (***Macrosiphum euphorbiae)***

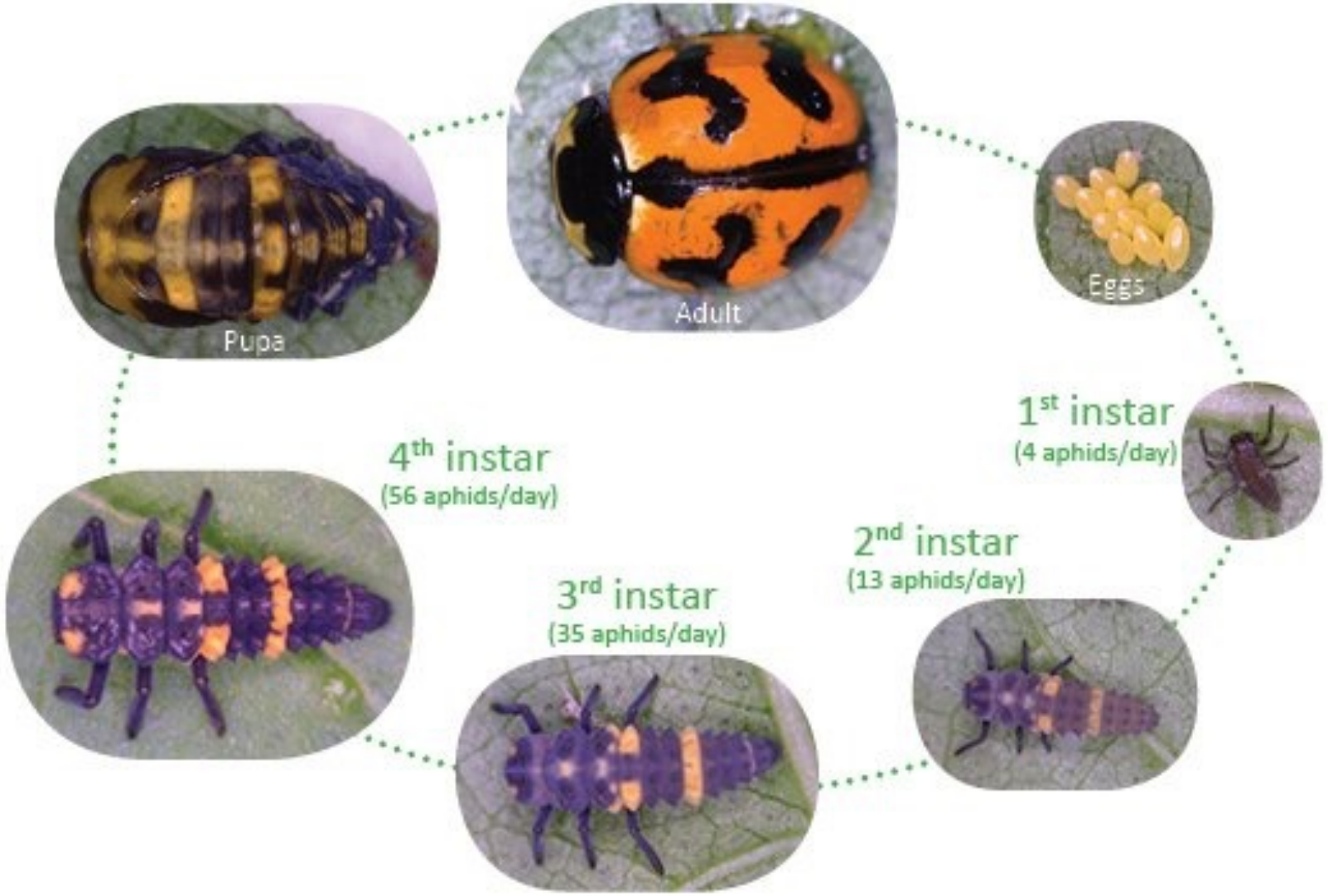


APHIDIUS ERVI

- aphid parasitoid
- Works best on potato aphids usally red, pink or green (***Macrosiphum euphorbiae)***
- Not very effective on melon aphids (**Aphis gossypii**)

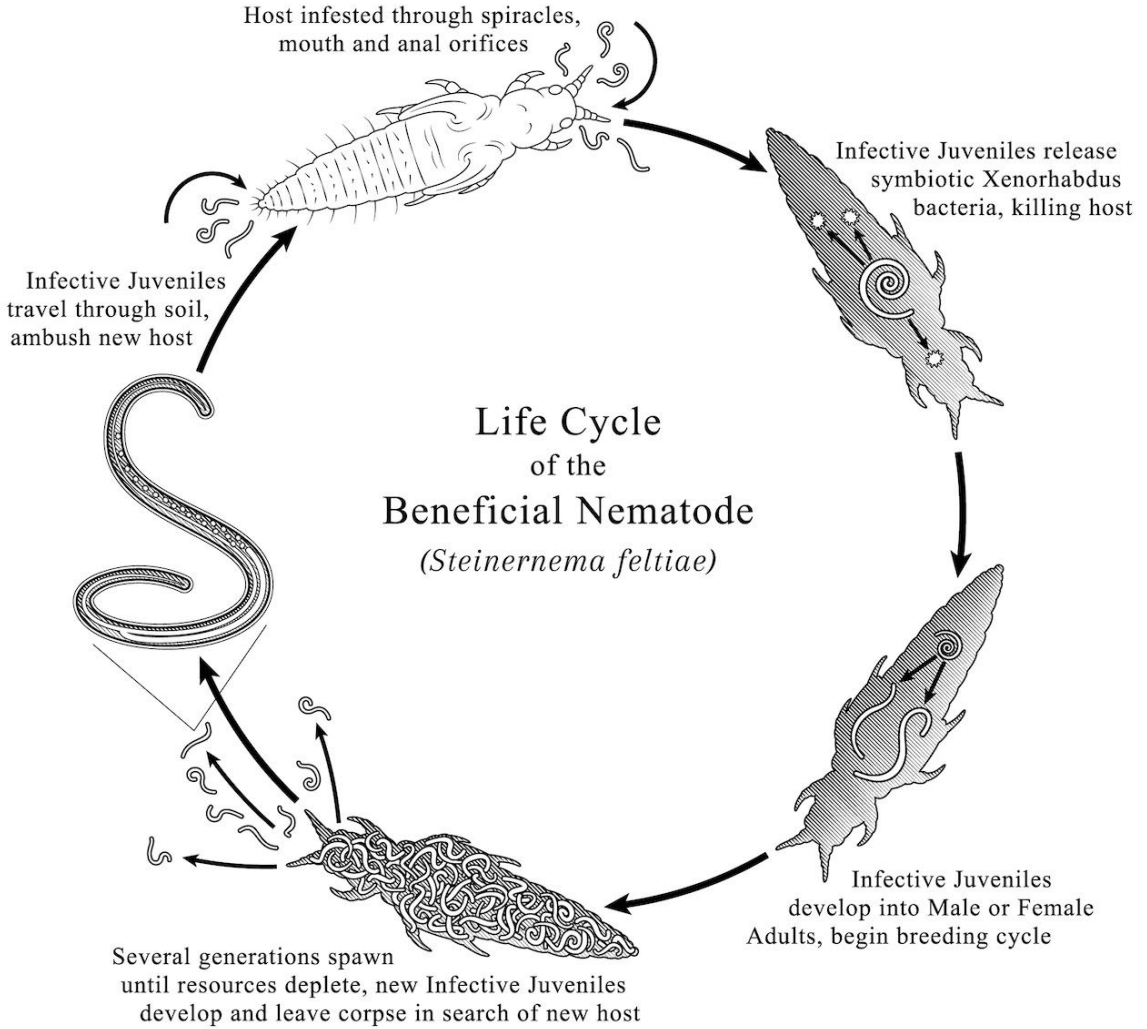
ADALIA BIPUNCTATA

- aphid predator
- Egg to adult development takes place in around 3 weeks at 20-25°C in which 4 larval stages with different size and predation capacity can be found.



STEINERNEMA FELTIAE

- Contains an insect-killing symbiotic bacterium
- Can be spray onto plants for control of thrips



© Sound Horticulture
Illustrations by Morgan Mahana

HETERORHABDITIS BACTERIOPHORA

- Contains an insect-killing symbiotic bacterium
- Life cycle is similar to that of Steinernema feltiae
- Fast and effective control of grubs and larvae of beetles
- Application rate of 500,000/m^2 of growing space

STEINERNEMA KRAUSSEI

- Works similarly to Steinernema feltiae; used for control of beetle and weevil larve
- Both preventative and curative

SHARED RESOURCES FOR SELF EDUCATION

- Bio Best website
- Koppert website
- Arbico Organics website
- Youtube/internet

WHERE TO BUY?

- Arbico organics
- BIO Best
- Koppert
- Griffens Greenhouse Supplies
- ***Check internet for other sources that may be available in your area/country***

IMPORTANT POINTS TO REMEMBER IN I.P.M.

- Scouting; you must find the problems as early as possible for best results
- You must purchase the correct organism for the target pest insect.
- The correct quantity must be purchased for the area you whish to treat REMEMBER THAT IT'S A NUMBERS GAME!
- The organisms must be at the right place at the right time and applied using the correct methods
- ALWAYS APPLY THEM IMEDIATELY UPON RECEIVING THEM!!!
- Check for predation/compatibility with other bio's

IMPORTANCE OF RETURNING UNTO GOD WHAT IS GODS'

- 25 And I will restore to you the years that the locust hath eaten, the cankerworm, and the caterpiller, and the palmerworm, ***my great army which I sent among you***. KJV — Joel 2:25
- 26 And ye shall eat in plenty, and be satisfied, and praise the name of the LORD your God, that hath dealt wondrously with you: and my people shall never be ashamed. KJV — Joel 2:26