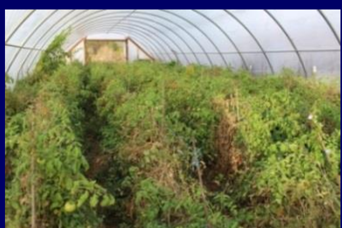
Great Plains Growers Conference And Trade Show

January 12, 2017
St. Joseph, MO

Managing Greenhouse Pests And Mites For Food Crops



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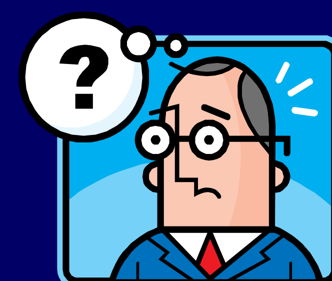
Overview: What To Expect

- Introduction
- Sanitation
- Scouting
- Pesticide applications

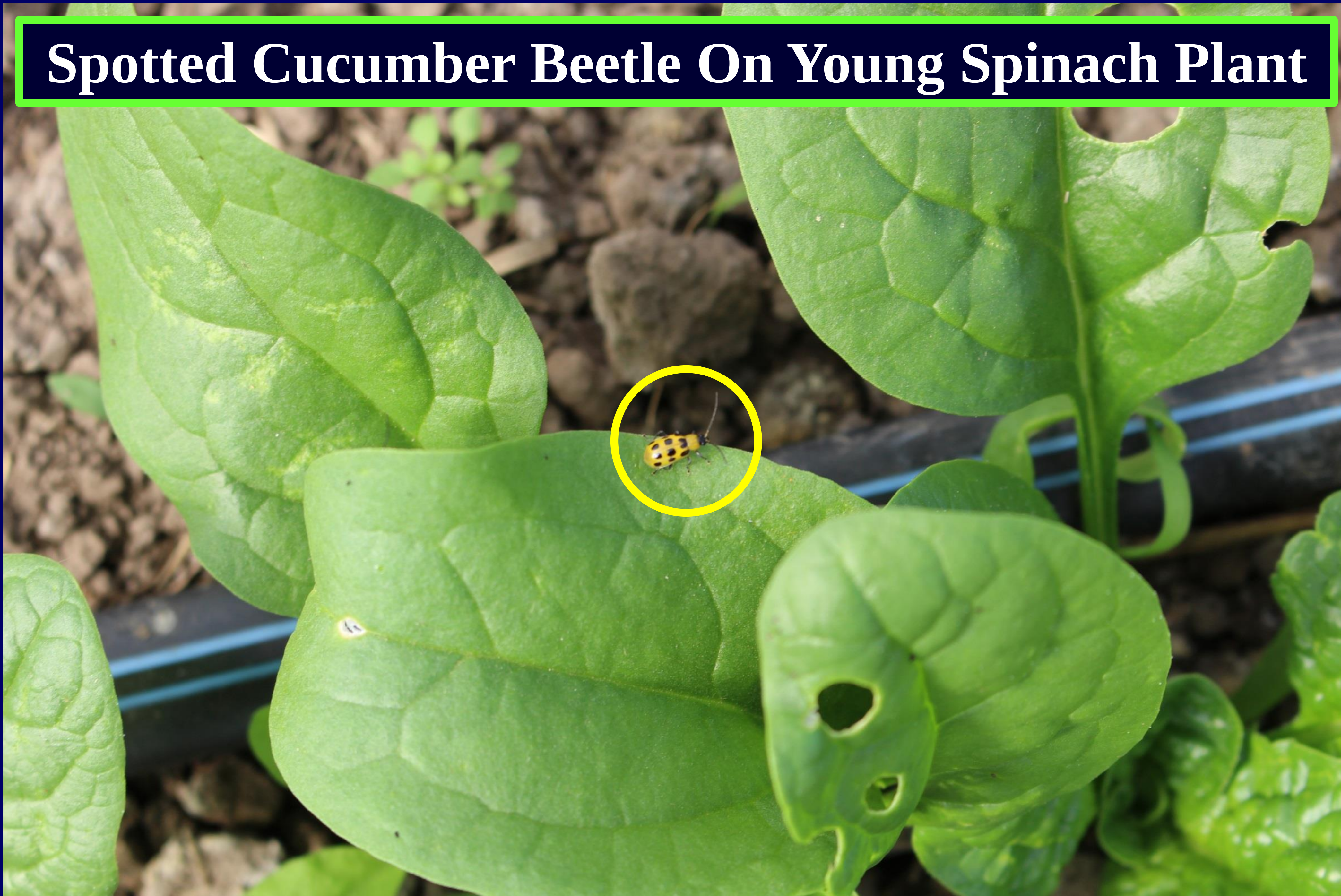
- Biological control



- Questions and discussion

Tomato Production System

Plant Protection Strategies Must Be Implemented As Soon As The Crop Is Planted Into The Greenhouse: Be Sure To Correctly Identify Insect And Mite Pests


Spotted Cucumber Beetle On Young Spinach Plant

Green Peach Aphids On Pepper Plant

Western Flower Thrips Damage To Peppers

Reproductive Capacity Of Certain Insect And Mite Pests Necessitates The Need To Implement Plant Protection Strategies Early In The Crop Production Cycle: "Numbers Game"

Aphid Reproduction (Parthenogenesis):
“Numbers Game”

“Many” Aphids Can Be Produced In A “Short” Period Of Time

In 5 Generations, A Single Green Peach Aphid Could Give Rise To 13,552,028 Individual Aphids (Harrison, 1969)

Green Peach Aphid (*Myzus persicae*): Vector Of Many Viruses

Western Flower Thrips, *Frankliniella occidentalis*

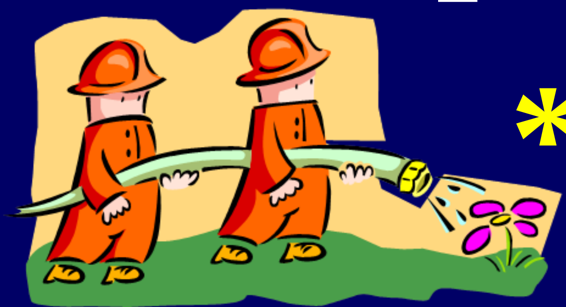
Plant Damage

*** <u>Direct:</u> feeding injury to leaves and flowers.**

*** <u>Indirect:</u> transmit the tospoviruses—*Impatiens necrotic spot* virus (INSV) and *Tomato spotted wilt* virus (TSWV).**

Cultural Practices And Sanitation

* Proper watering (irrigation)



* Proper fertility

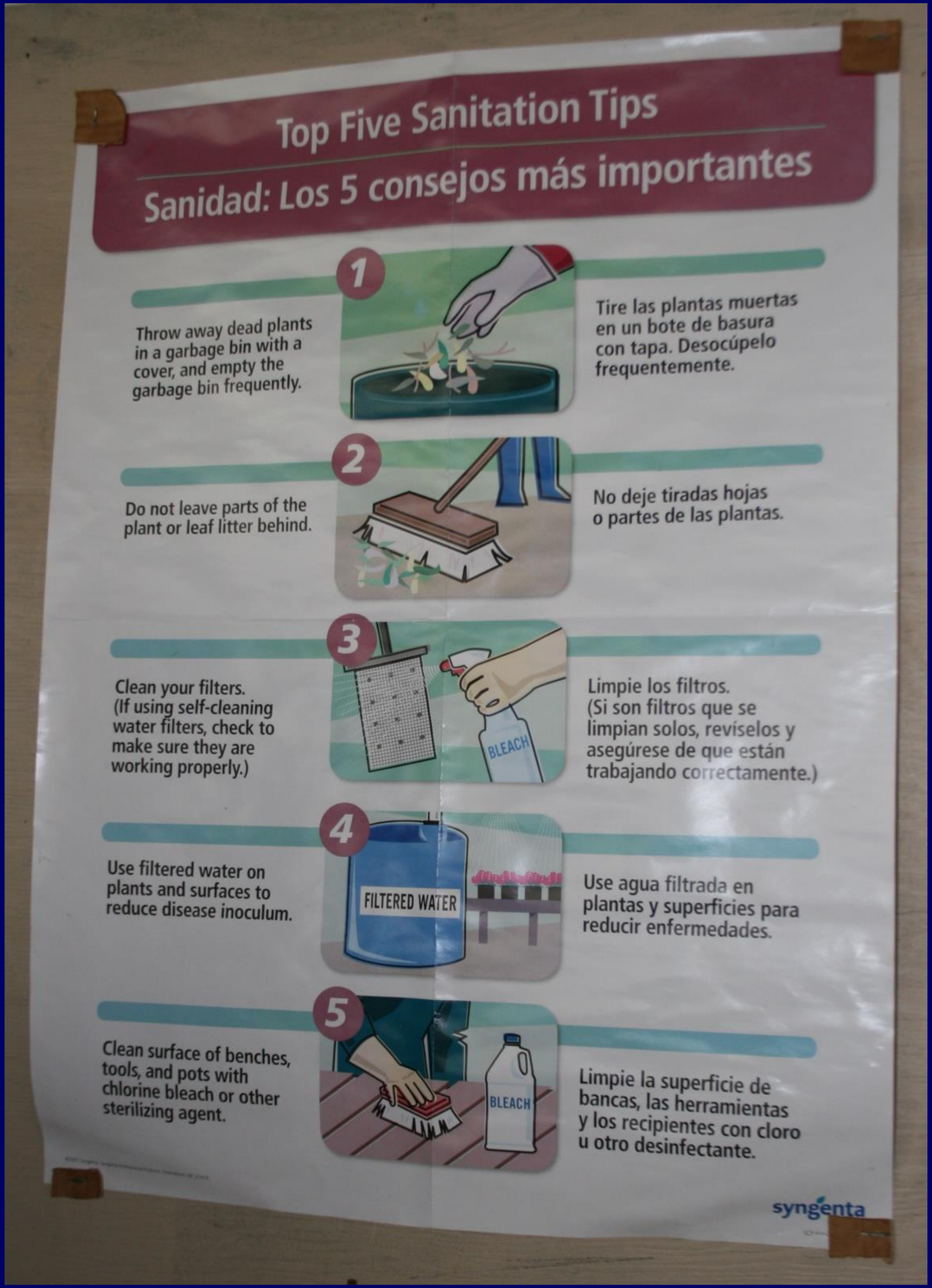
* Proper spacing

* Removal of all weeds, and plant and growing medium debris

The "First Line Of Defense" Against Insect And Mite Pests, And Plant Diseases Involves Implementing Appropriate Sanitation Practices

Top Five Sanitation Tips

1. Throw Away Dead Plants
2. Pick-Up All Plant And Leaf Litter
3. Clean Filters
4. Use Filtered Water
5. Clean Bench Surfaces, Tools, And Containers



Sanitation: "First Line Of Defense" Against Insect (And Mite) Pests

Greenhouse Sanitation

* Place all debris in containers with tight-sealing lids or dispose of into "compost piles"

* Remove or "eliminate" algae from benches and floors

* Remove weeds, and plant material and growing medium debris

* Dispose of old stock plants or any left-over plant material

Weeds Growing Underneath Bench

Importance Of Weed Management

- Many broadleaf weeds are susceptible to and serve as a refuge or alternate host for insect and mite pests; including: aphids, whiteflies, spider mites, and thrips.

- A number of weeds may also harbor the viruses vectored by aphids, whiteflies, and thrips.

Many Weeds Serve As Reservoirs For Insect And Mite Pests

Spider Mite Feeding Damage On Weed Among Tomato Plants

Spider Mites On Weed Among Tomato Crop

ROLE OF WEEDS IN THE INCIDENCE OF VIRUS DISEASES

JAMES E. DUFFUS

Sugarbeet Investigations, Plant Science Research Division, Agricultural Research Service, U.S. Department of Agriculture, Salinas, California

INTRODUCTION

From the standpoint of control of virus diseases, there is perhaps no phase of virology more important than epidemiology. The role of weeds in the occurrence and spread of plant virus diseases is an integral part of the ecological aspect of virus transmission.

“Compost” Pile Outside Of Greenhouse:

Is There A Location Issue?

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Soil & Tillage Research 72 (2003) 203–211

Soil & Tillage Research

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Soil fertility management and insect pests: harmonizing soil and plant health in agroecosystems

Miguel A. Altieri*, Clara I. Nicholls

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Received 5 March 2002; accepted 3 March 2003

Abstract

Cultural methods such as crop fertilization can affect susceptibility of plants to insect pests by altering plant tissue nutrient levels. Research shows that the ability of a crop plant to resist or tolerate insect pests and diseases is tied to optimal physical, chemical and mainly biological properties of soils. Soils with high organic matter and active soil biology generally exhibit good soil fertility. Crops grown in such soils generally exhibit lower abundance of several insect herbivores, reductions that may be attributed to a lower nitrogen content in organically farmed crops. On the other hand, farming practices, such as excessive use of inorganic fertilizers, can cause nutrient imbalances and lower pest resistance. More studies comparing pest populations on plants treated with synthetic versus organic fertilizers are needed. Understanding the underlying effects of why organic fertilization appears to improve plant health may lead us to new and better integrated pest management and integrated soil fertility management designs.

Keywords: Soil fertility; Crop nutrition; Pest attack; Insect populations; Pest management

Annu. Rev. Entomol. 2002. 47:817–44

HOST PLANT QUALITY AND FECUNDITY IN HERBIVOROUS INSECTS

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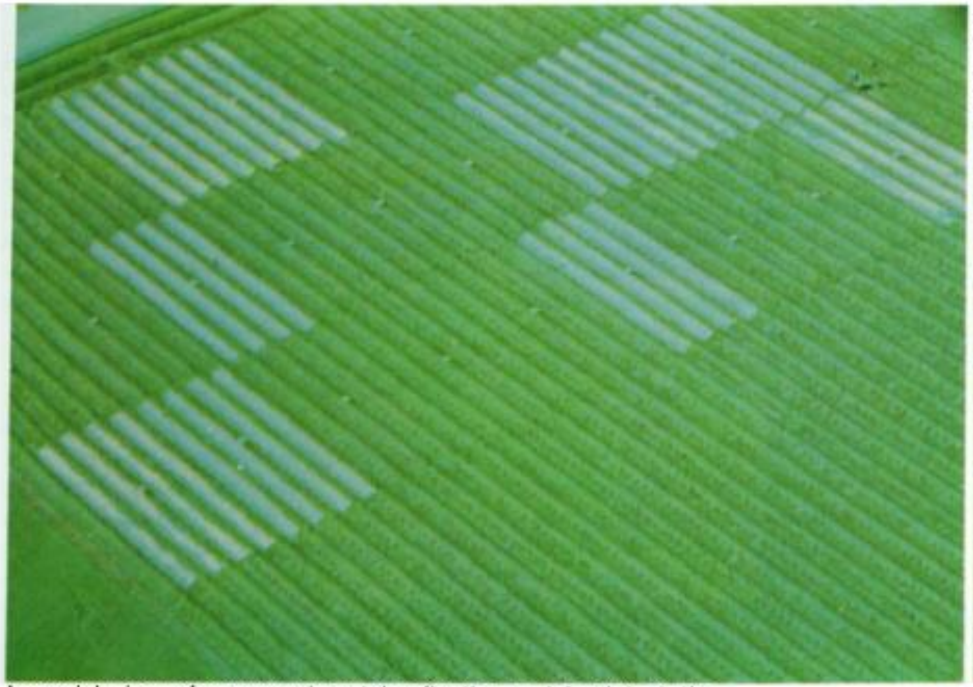
Key Words herbivory, offspring size, oviposition preferences, larval performance, nutrients, defensive metabolites

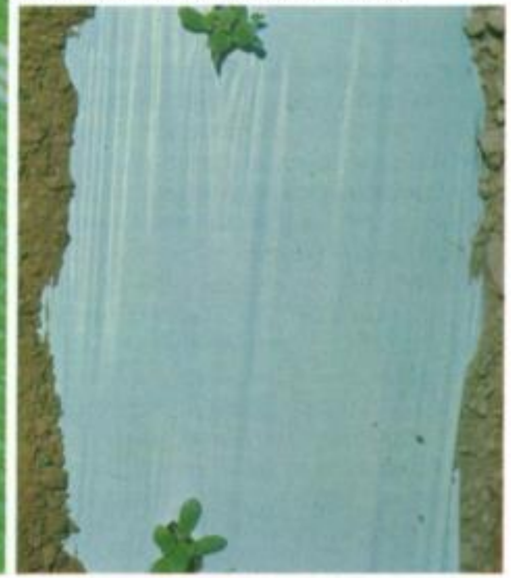
■ **Abstract** Host plant quality is a key determinant of the fecundity of herbivorous insects. Components of host plant quality (such as carbon, nitrogen, and defensive metabolites) directly affect potential and achieved herbivore fecundity. The responses of insect herbivores to changes in host plant quality vary within and between feeding guilds. Host plant quality also affects insect reproductive strategies: Egg size and quality, the allocation of resources to eggs, and the choice of oviposition sites may all be influenced by plant quality, as may egg or embryo resorption on poor-quality hosts. Many insect herbivores change the quality of their host plants, affecting both inter- and intraspecific interactions. Higher–trophic level interactions, such as the performance of predators and parasitoids, may also be affected by host plant quality. We conclude that host plant quality affects the fecundity of herbivorous insects at both the individual and the population scale.

Reflective Mulches: May Reduce The Incidence Of Certain Insect Pests



An aerial view of an experimental reflective mulch plot at the Meloland Field Station near Riverside.

Below are seen plants that were established 18 inches apart through holes in the mulch. Later tests developed a system for laying down the mulch strips mechanically.



Reflective mulches foil insects

Nick C. Toscano ☐ Jeff Wyman ☐ Ken Kido
Hunter Johnson, Jr. ☐ Keith Mayberry

Above are 30-inch-wide mulch strips which were hand applied on the south slope of the squash planting beds.

Photos by Max Clover

Scouting Food Crops Is Important In Determining The Population Dynamics Of Insect And Mite Pests Throughout The Growing Season

What Can Happen When You "Forget" To Scout: Lots Of Twospotted Spider Mites (*Tetranychus urticae*) On Tomato

Developing A Routine Scouting Schedule Will Prevent Insect And Mite Pest Problems From "Escalating"

Yellow Sticky Cards: Capture Adult Thrips, Whiteflies, And Moths

Yellow Sticky Tape: Capture Flying Insects Such As Winged Aphids, Adult Thrips, Adult Whiteflies, Beetles, And Moths

Using Pesticides To Suppress Insect And/Or Mite Pest Populations On Greenhouse-Grown Food Crops

Pesticides (Insecticides And Miticides) For Use On Vegetable Crops

- **Contact Pesticide**
- **Stomach Poison**

Pesticide Types

* Broad-spectrum: have activity on many insect and mite pests with “long” residual activity or persistence.

* Narrow-spectrum (selective): active on a select number of insect or mite pests and have “short” residual activity or persistence.

How To Effectively Use Pesticides

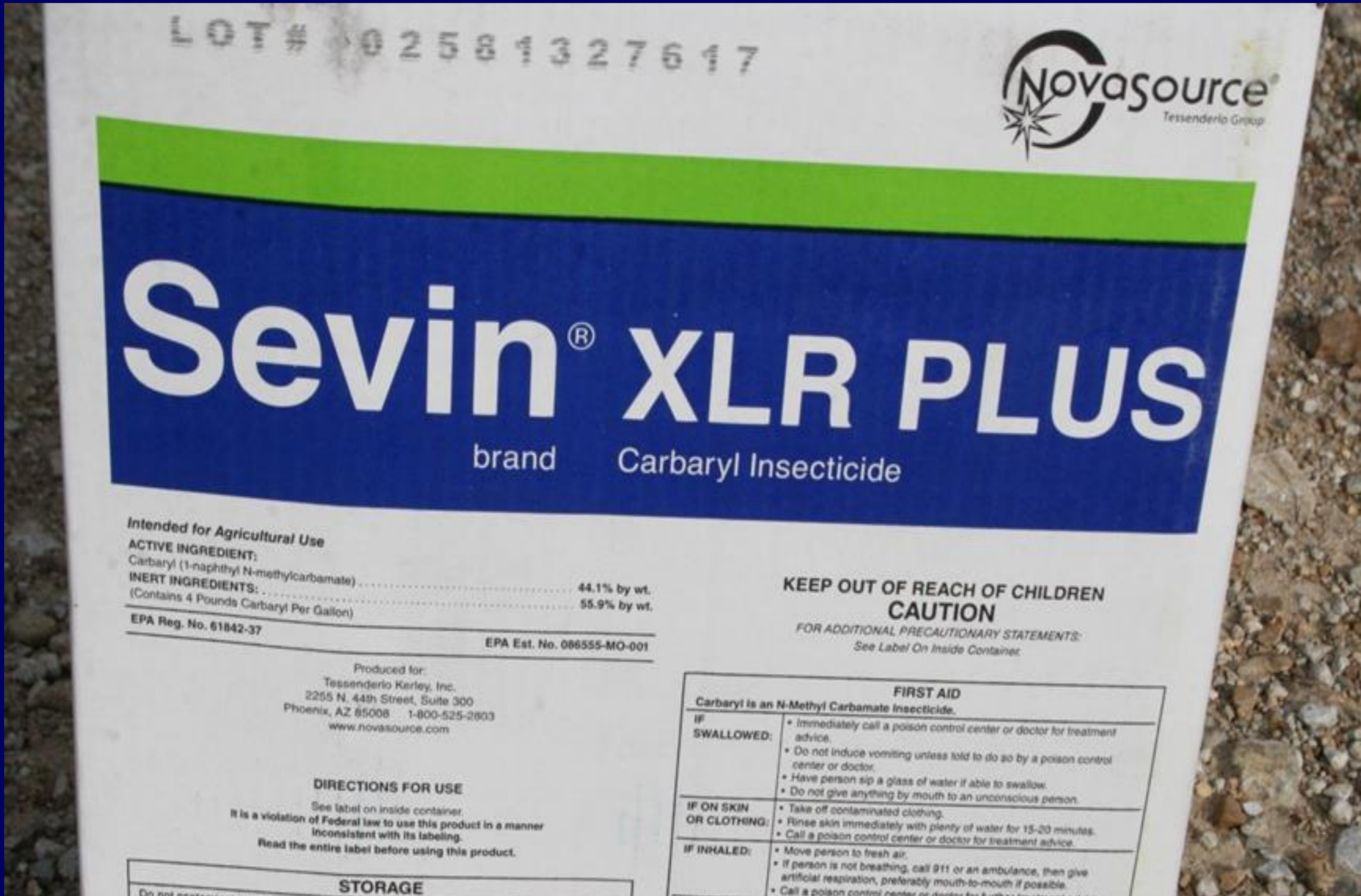
1. Timing: apply pesticides (insecticides and miticides) when the most susceptible life stage (e.g. larva, nymph, and adult) of a given insect or mite pest is present.

2. Coverage: when spraying a pesticide, it is important to obtain thorough coverage of all plant parts including: leaves, stems, flowers, and fruits.

3. Frequency: apply pesticides within timely intervals, which is dependent on the residual activity of a given pesticide. Read the label for information associated with frequency of application.

The Life Stages (Eggs, Larvae, Nymphs, Pupae, And Adults) Of Insect And Mite Pests Are Typically Located On Leaf Undersides

Some Pesticides Can Directly And Indirectly Impact Insect And Mite Pest Populations: Kill Natural Enemies Or Stimulate Pest Outbreaks (Secondary Pest Outbreaks)



Carbaryl (Sevin): Broad-Spectrum Insecticide That Is Directly And Indirectly Harmful To Natural Enemies And Pollinators

Applications Of Certain Pesticides Such As Pyrethroids May Stimulate Twospotted Spider Mite Outbreaks

Even Pesticides Certified For Use In "Organic" Production Systems May Be Directly Or Indirectly Harmful To Natural Enemies

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Using organic-certified rather than synthetic pesticides may not be safer for biological control agents: Selectivity and side effects of 14 pesticides on the predator *Orius laevigatus*

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ABSTRACT

The generalist predator *Orius laevigatus* (Fieber) (Hemiptera: Anthocoridae) is a key natural enemy of various arthropods in agricultural and natural ecosystems. Releases of this predator are frequently carried out, and it is included in the Integrated Pest Management (IPM) programs of several crops. The accurate assessment of the compatibility of various pesticides with predator activity is key for the success of this strategy. We assessed acute and sublethal toxicity of 14 pesticides on *O. laevigatus* adults under laboratory conditions. Pesticides commonly used in either conventional or organic farming were selected for the study, including six biopesticides, three synthetic insecticides, two sulfur compounds and three adjuvants. To assess the pesticides' residual persistence, the predator was exposed for 3 d to pesticide residues on tomato sprouts that had been treated 1 h, 7 d or 14 d prior to the assay. The percentage of mortality and the sublethal effects on predator reproductive capacity were summarized in a reduction coefficient (E_x) and the pesticides were classified according to the IOBC (International Organization for Biological Control) toxicity categories. The results showed that the pesticides greatly differed in their toxicity, both in terms of lethal and sub lethal effects, as well as in their persistence. In particular, abamectin was the most noxious and persistent, and was classified as harmful up to 14 d after the treatment, causing almost 100% mortality. Spinosad, emamectin, metaflumizone were moderately harmful until 7 d after the treatment, while the other pesticides were slightly harmful or harmless. The results, based on the combination of assessment of acute mortality, predator reproductive capacity pesticides residual and pesticides residual persistence, stress the need of using complementary bioassays (e.g. assessment of lethal and sublethal effects) to carefully select the pesticides to be used in IPM programs and appropriately time the pesticides application (as function of natural enemies present in crops) and potential releases of natural enemies like *O. laevigatus*.

The influence of chemical management of pests, diseases and weeds on pest and predatory arthropods associated with tomatoes

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Accepted 6 November 1997

Abstract

The effects of selected pesticide application regimes on pest predator populations as well as pests were investigated in tomato (*Lycopersicon esculentum* L.) agroecosystems. The treatments included: (i) the full spectrum of recommended pesticides, including insecticides (carbaryl, endosulfan, and esfenvalerate), a fungicide (chlorothalonil), and herbicides (trifluralin and paraquat); (ii) only insecticides, using the same insecticides and doses as in the full-spectrum pesticide treatment; (iii) only fungicides and herbicides; using the same fungicides and herbicides and doses as in the full-spectrum pesticide use treatment; (iv) control plots which received no pesticide applications. In 1994, the insecticides controlled aphids and flea beetles and reduced their populations by 85% and 72%, respectively. However, aphid populations were 125% greater in the insecticide-treated plots than in the control plots in 1995. The fungicides and herbicides caused increases in the numbers of aphids by 33% in 1994 and by 39.8% in 1995 and those of flea beetles by 55% in 1994 and 17% in 1995. All the full-spectrum pesticide treatments had some degree of detrimental effects on populations of predatory arthropods. The different pesticide applications reduced coccinellid beetle *Coleomegilla maculata* (Col: Coccinellidae), populations by 6.6% to 35.5% in 1994 but only slightly in 1995; Anthocoridae (Heteroptera) numbers by 26.2% to 55.8% in 1994 and 13.5% to 38.8% in 1995; spider (Araneae) populations by 44.6% to 70.9% in 1994 and 37.0% to 91.4% in 1995. Five hypotheses are proposed to explain these results: (1) the fungicide and herbicide applications reduced the populations of predatory arthropods which in turn resulted in higher pest populations; (2) the fungicide and herbicide applications suppressed the fungal parasites of the pests; (3) the applications increased the fecundity of the pests and resulted in more offspring of the pests and hence higher populations; (4) the applications caused some physiological changes in the tomato plants that attracted more pests or stimulated their reproduction and; (5) the fungicide applications provided more nutritious and suitable habitats for the pests by suppressing the disease of the tomatoes.

INERTS?

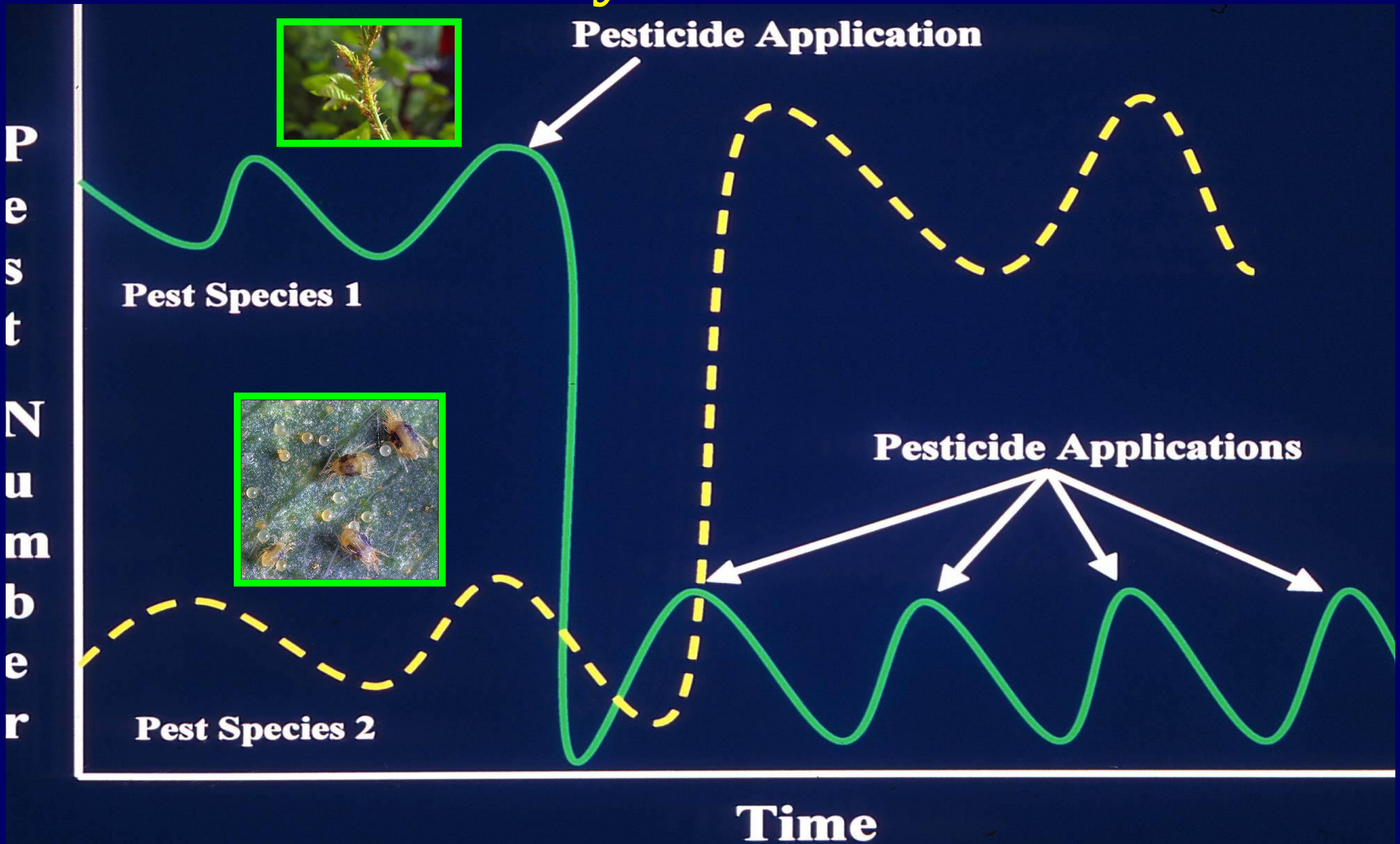
14?

Keywords: Pests; Predators; Pesticides; Non-target effects; Tomatoes

Ecological Impact Of Pesticide Use On Natural Enemies

* Secondary Pest Outbreaks

Secondary Pest Outbreak



Selective Insecticide: ***Bacillus thuringiensis*** **subsp.** ***kurstaki*** **(Dipel®)—Only Kills Caterpillars.**

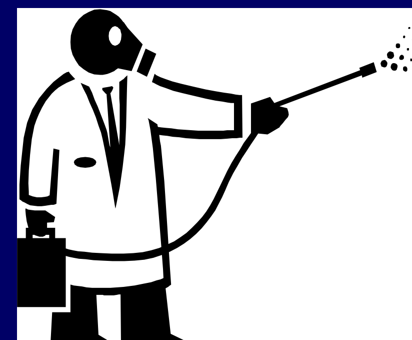
Selective Insecticide:

Spinosad (Entrust®). Active On Certain Insect Pests.

Factors Responsible For Inadequate “Control” Of Insect And Mite Pests

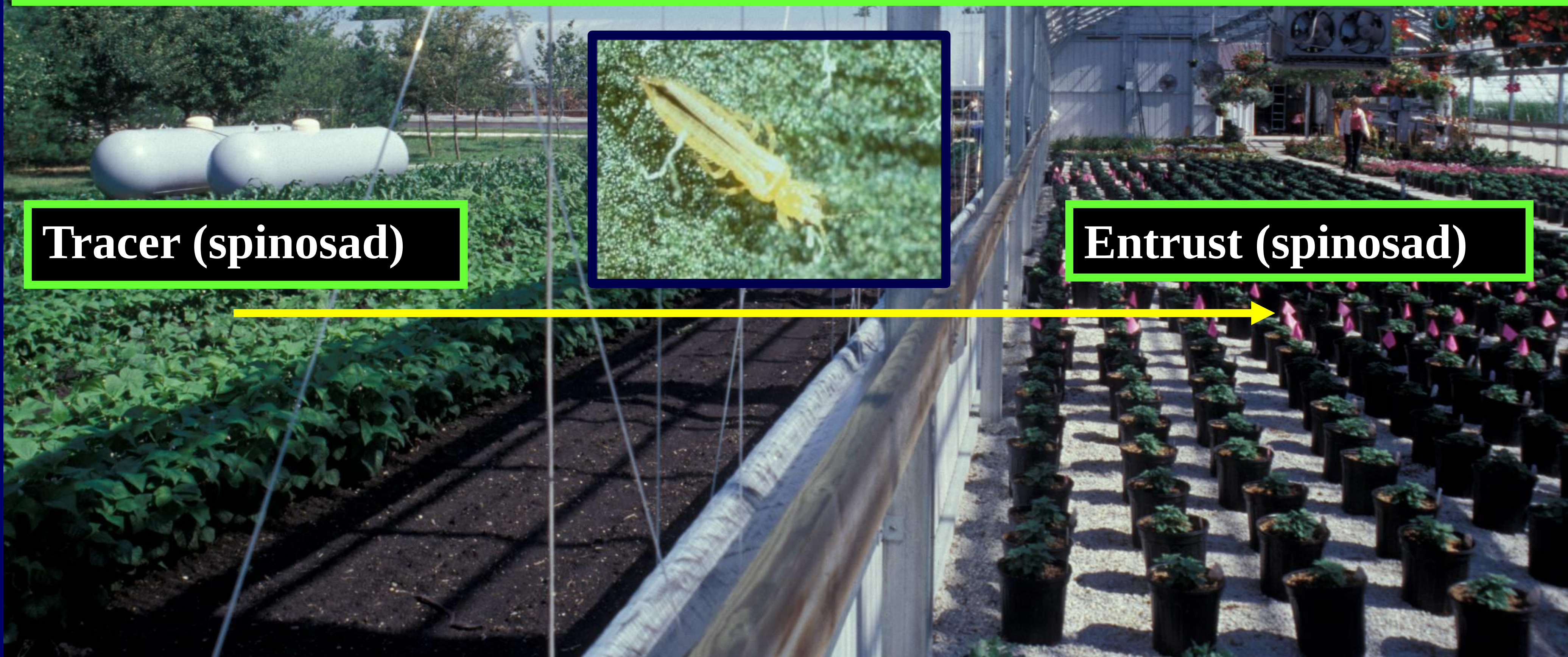
- Spray timing: life stages of insect and mite pests present

- Spray coverage
- pH of spray solution



- Frequency of applications
- Migration of insects into greenhouses from other sources

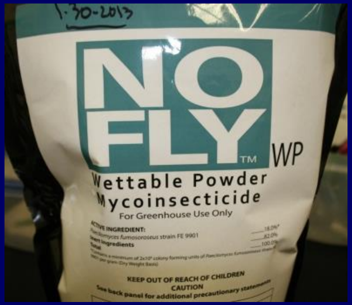
Immigration Of Insect Pests Such As The Western Flower Thrips Into Greenhouses From Nearby Fields: May Be Exposed To Insecticides With The Same Mode Of Action



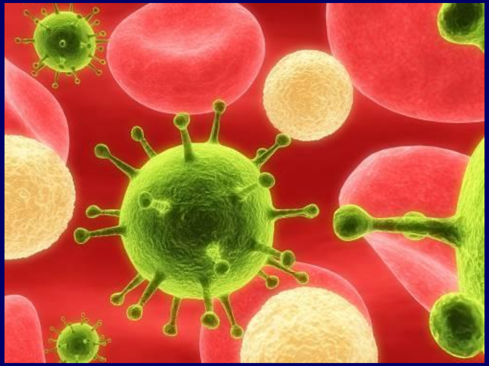
Be Careful Using Pesticides In The Presence Of Bumble Bees:
Direct And Indirect Effects

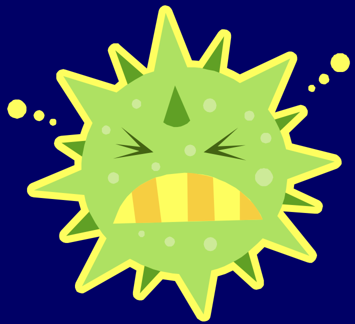
Insecticides Commercially-Available In USA Based On Entomopathogenic (Beneficial) Organisms (Fungi Or Bacteria)

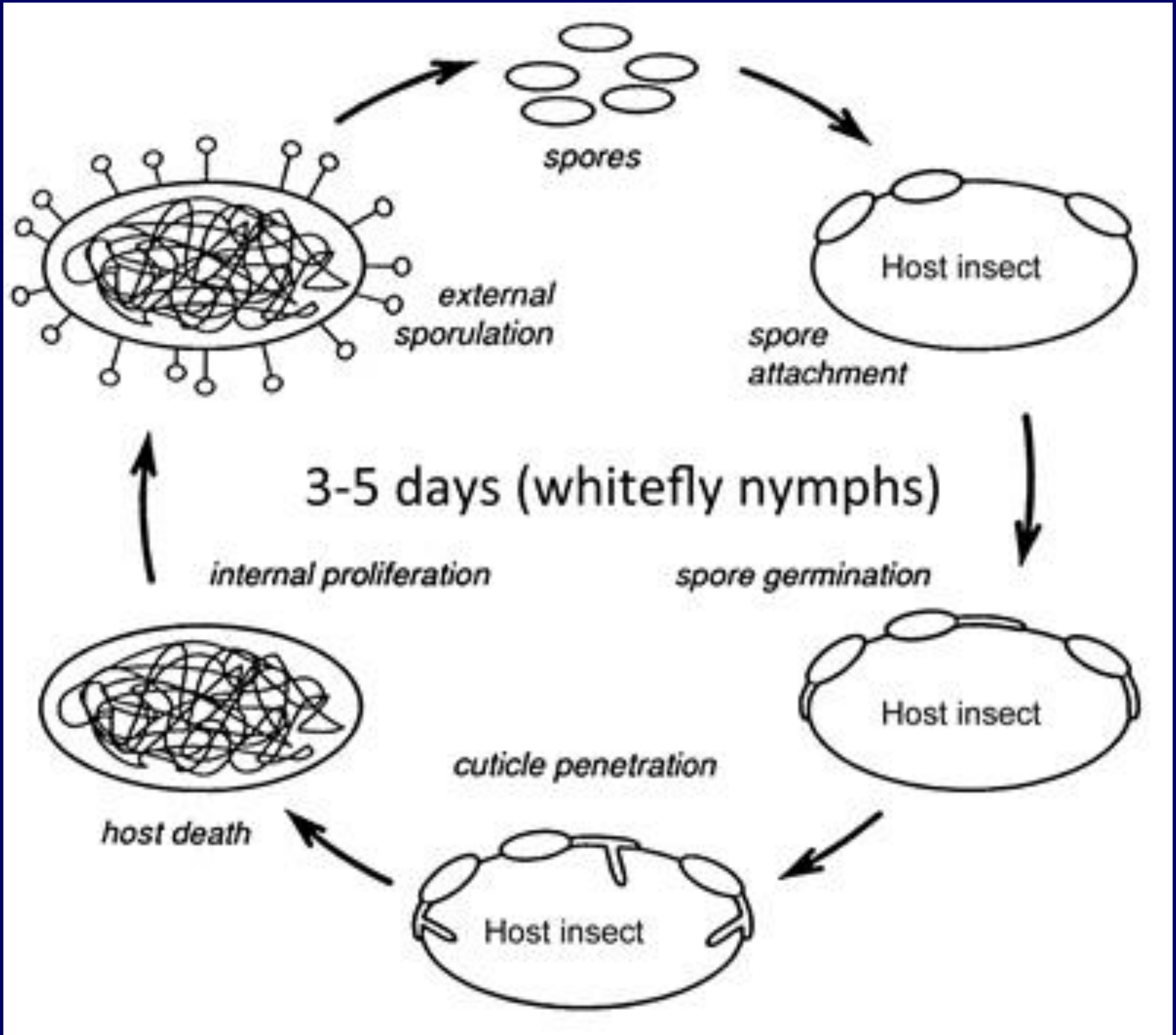
- *Beauveria bassiana* (BotaniGard/Mycotrol)
- *Isaria fumosoroseus* strain FE 9901 (NoFly)
- *Isaria fumosorosea* Apopka Strain 97 (Preferal)
- *Metarhizium anisopliae* (Met52)
- *Chromobacterium subtsugae* Strain PRAA4-1^T (Grandvevo)



How Beneficial Fungi Kill Insect Hosts



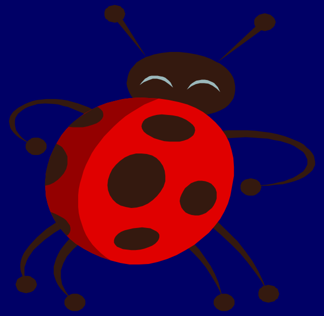




Alternative Plant Protection Strategy: Biological Control

What Is Biological Control?

- Use of biological control agents (=natural enemies) such as parasitoids and predators to regulate insect and/or mite pest populations.
- Natural enemies will not eradicate an insect and/or mite pest population. The success of natural enemies is contingent on maintaining insect and/or mite pest numbers at levels low enough to minimize plant damage.



- Key=regulation of insect and/or mite pest populations.

Biological Control Products Available From Suppliers/Distributors

Types Of Biological Control Agents (Natural Enemies)

1. Parasitoids

2. Predators:

* Hover flies
* Green lacewings
* Ladybird beetles
* Predatory midges
* Predatory mites

Parasitoids: Aphids

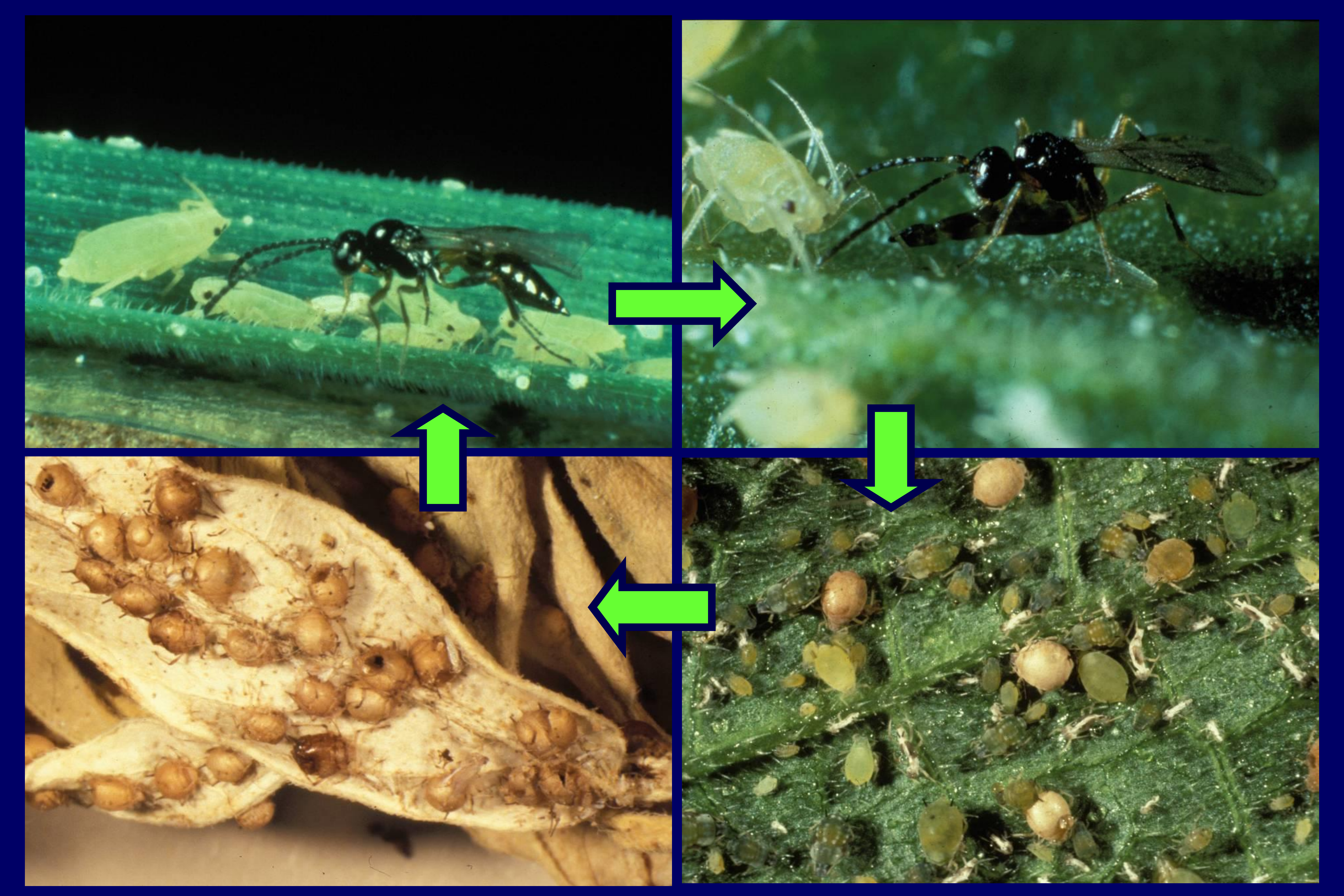
- *Aphidius colemani* (green peach and cotton/melon aphid)

- *Aphidius ervi* (potato and foxglove aphid)

- *Aphidius matricariae* (tobacco aphid)
- *Aphelinus abdominalis* (wide-range of aphid species)

Female Parasitoid Getting Ready To Attack An Aphid

Parasitized "Mummified" Aphids On Plant



Methods (Formulations) Of Releasing Aphid Parasitoids

Banker Plant System

Both Alive And “Mummified” Aphids On Banker Plant

Parasitized (“Mummified”) Aphids On Leaf Underside

Banker Plants

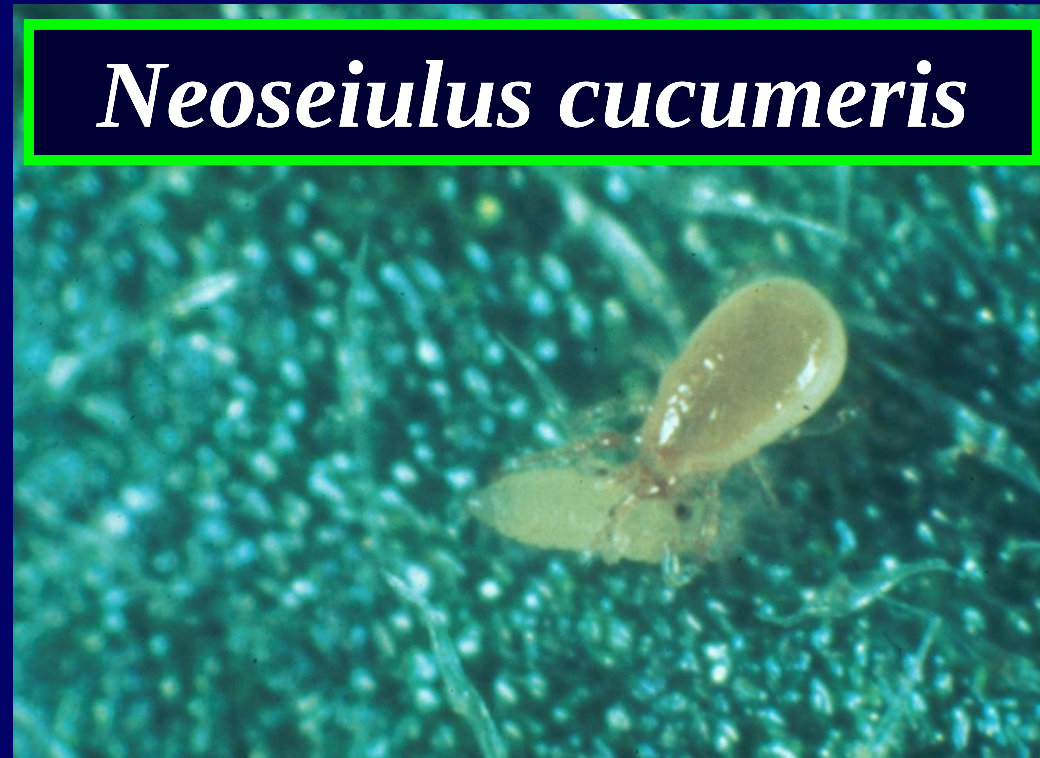
Aphids For Banker Plants

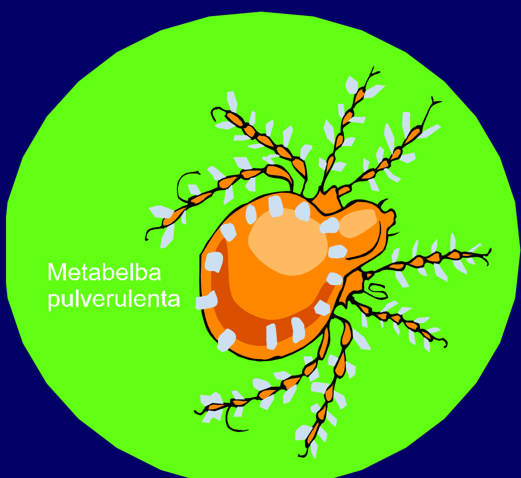

Incorporate Plants Into Greenhouse Production Systems
That Attract Natural Enemies Such As Sweet Alyssum

Green Lacewing: Predator Of Aphids And Mites

Predatory Mite

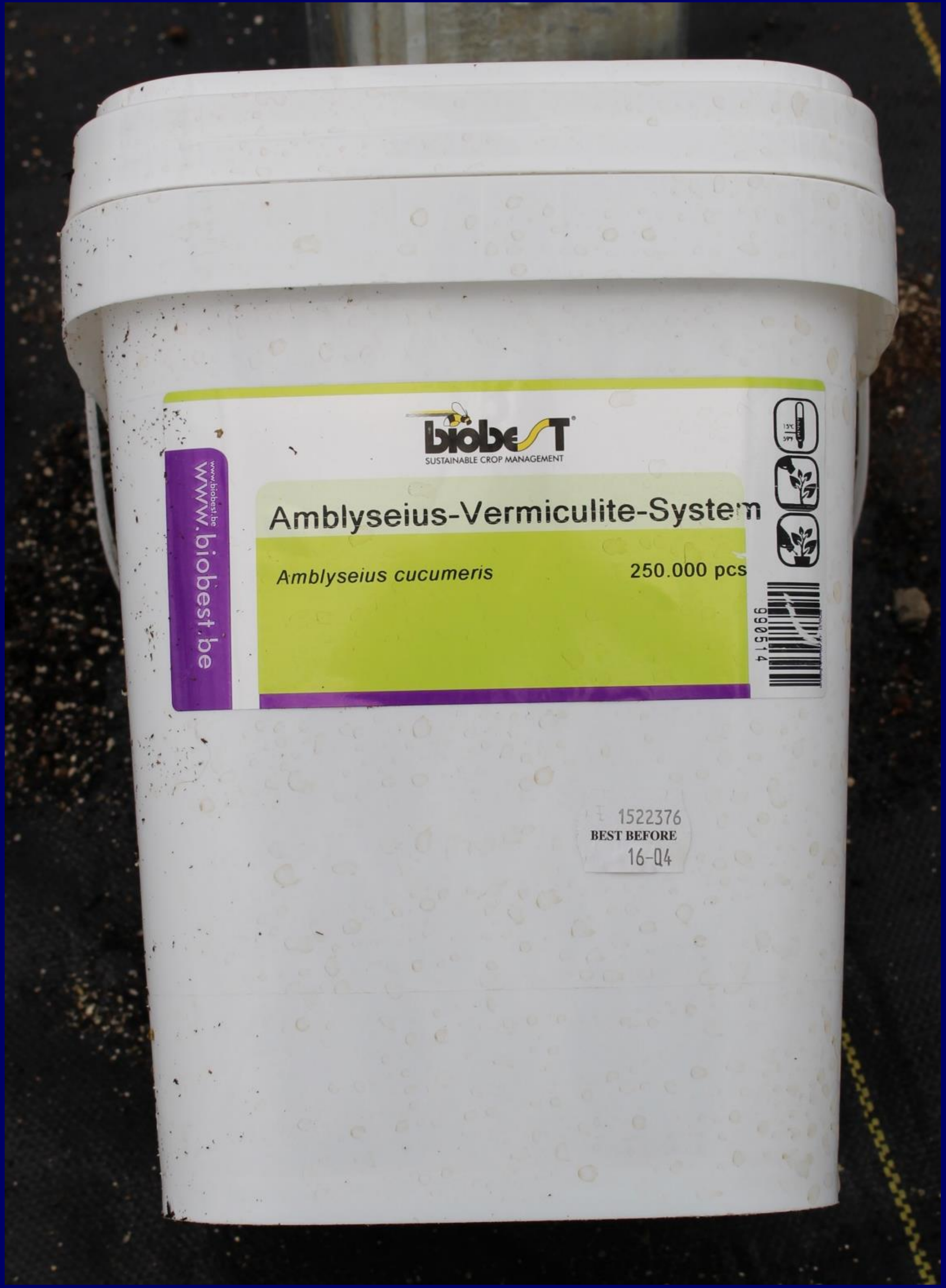

Neoseiulus californicus


Neoseiulus cucumeris

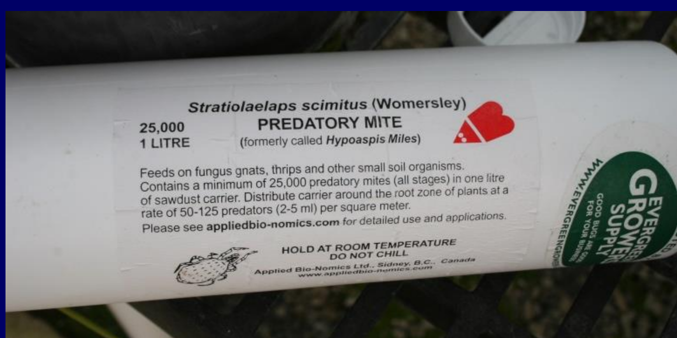

Metabelba
pulverulenta


Phytoseiulus persimilis

Container With Approximately 250,000 Predatory Mites That Are Distributed Either By Hand Or Using A Mechanical Blower



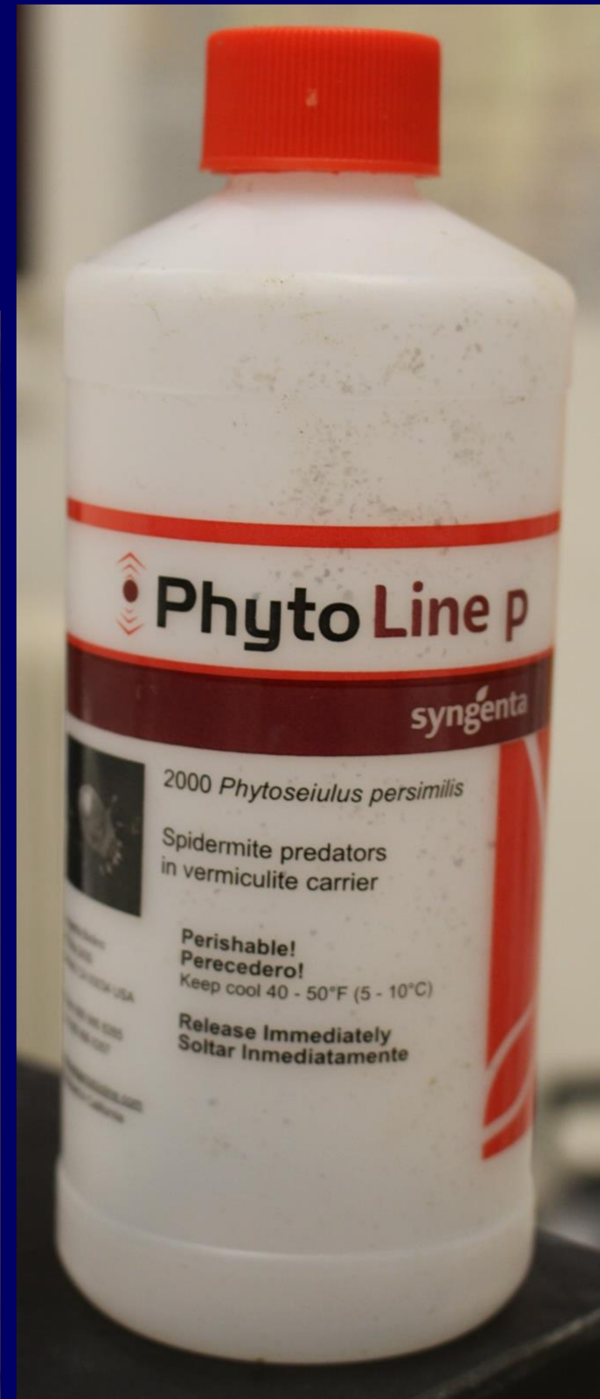
Methods Of Applying Predatory Mites



Amblyseius swirskii Sachet Breeding System

Method Of Applying *Neoseiulus cucumeris* (Sachet)

Shipment Of Biological Control Agents (Natural Enemies) From Commercial Supplier



Container Of *Phytoseiulus persimilis* After Introduction

Be Sure To Make Releases Of Biological Control Agents (Natural Enemies) Early In The Production Cycle

Also, Be Sure To Receive Shipments Every Week Or Every Two Weeks

Tomato Crop Using Biological Control Against Twospotted Spider Mite

Key: Release Rates And Release Timing

Cucumber Crop In Another Enclosed Structure (Hoop-House) That Did Not Use Biological Control Against Twospotted Spider Mite

The Success Of Biological Control May Vary Depending On Plant Type: Plant Architecture And Leaf Characteristics (Hairs Or Trichomes)

Summary

* Be sure to correctly identify all insect and mite pests

* Start plant protection strategies early in the cropping cycle

* Implement sanitation practices

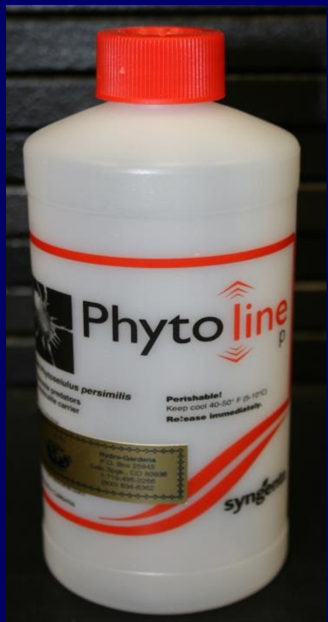
* Avoid over-fertilizing vegetable crops

* Establish a reliable scouting program

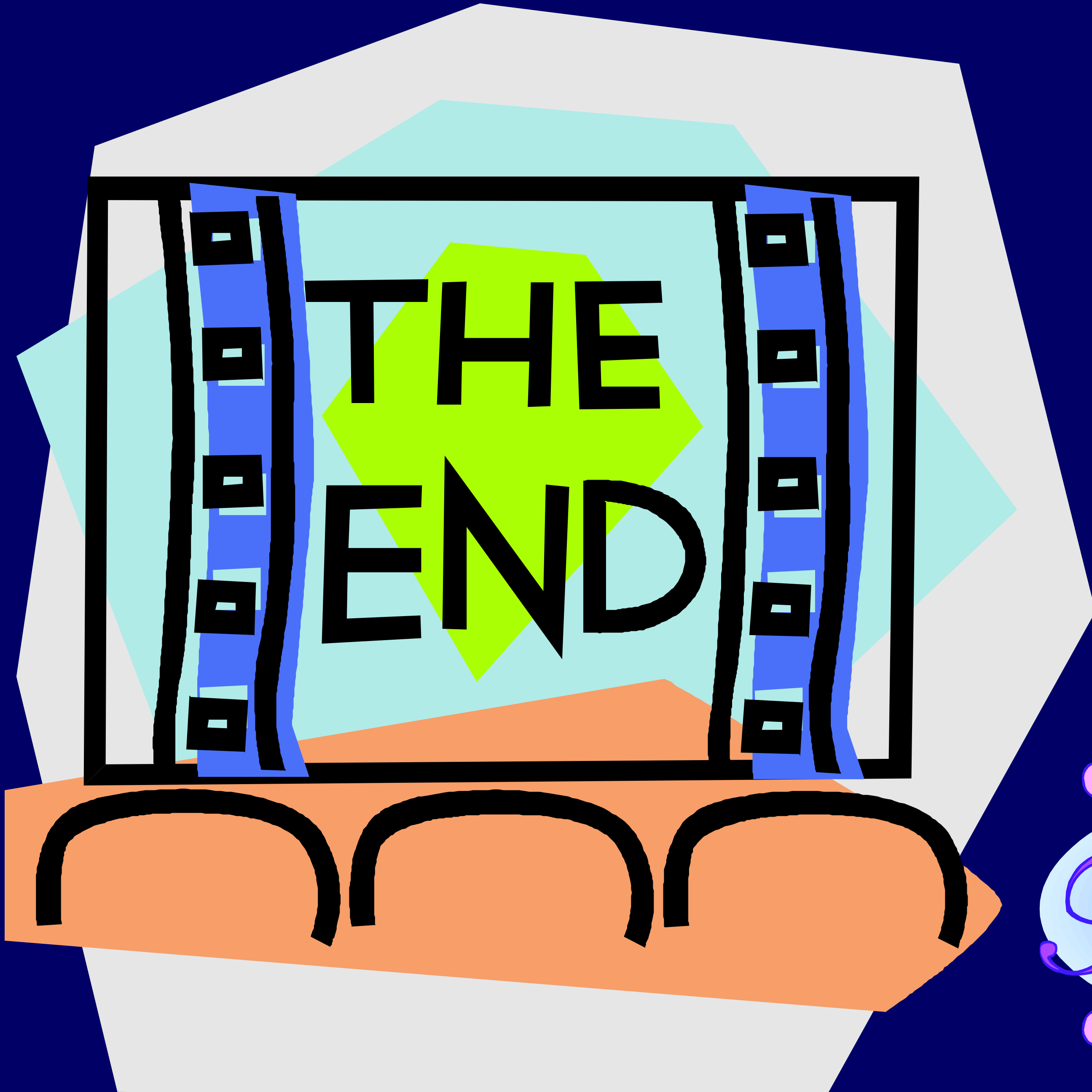
* Use pesticides appropriately

* Use biological control agents preventatively

Thank You For Your Attention!



I Hope You All Learned Something!


THE
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DONE!

The End

It's QUESTION TIME!!