In-Service Education: Fostering Adoption of IPM by Vegetable Farmers in Missouri
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Reduced-Risk Insecticides and Biopesticides for Field and High Tunnel Vegetable Production

Raymond A. Cloyd
Professor, Extension Specialist in Ornamental Entomology/Integrated Pest Management
Kansas State University, Manhattan, KS
Phone: 785-532-4750 Email: rcloyd@ksu.edu
Overview of Presentation

• Introduction

• Types of Pesticides

• Reduced-Risk Pesticides and Biopesticides

• Questions and Discussion
Field Vegetable Production
Field Vegetable Production
High Tunnel Vegetable Production
Insect and Mite Pest Feeding Behaviors

- Chewing
- Sucking (Piercing-Sucking)
- Mining
- Boring
- Galling
Insect and Mite Pest Feeding Behaviors

- **Phloem-Feeders**: Aphids, Whiteflies, Mealybugs, and Scales
- **Xylem-Feeders**: True Bugs, Spittlebugs, and Leafhoppers (in general)
- **Chewers**: Beetles, Caterpillars, and Grasshoppers
- **Miners**: Leafminers
- **Chlorophyll-Feeders**: Spider Mites and Lace Bugs
- **Mesophyll and Epidermal Fluid-Feeders**: Thrips
Common Insect and Mite Pests

- **Chewers**
  - Caterpillars: cabbageworm, corn earworm, cutworms, diamondback moth, and hornworms
  - Beetles: Colorado potato beetle, cucumber beetle, flea beetles, striped cucumber beetle, and white grubs
  - Grasshoppers

- **Suckers**
  - Aphids
  - Spider mites
  - Squash bug
  - Leafhoppers
  - Lygus bug

- **Borers**
  - Squash vine borer
Types of Pesticides

- Conventional
- “Alternative”
- Botanical
- Reduced-Risk
- Biopesticide (Selective)
What Is A Conventional Pesticide?

• Among the most popular chemical control agents (e.g., pesticides) due to their being readily available, rapid acting, and highly effective (reliable). One application may “control” or suppress populations of several different pest species and usually forms a persistent residue that continues to kill insect pests for hours or days following an application. Typically associated with pesticides in the following chemical classes: organophosphate, carbamate, and pyrethroid.
What Is A Reduced-Risk Pesticide and Biopesticide (Selective Pesticide)?
Reduced-Risk Pesticides

• Class of compounds that pose a low health risk to humans and the environment. Considered to be “alternative” to organophosphate-based insecticides.

• Reduced-risk pesticides are designed to accomplish the following: 1) reduce pesticide risks to human health, 2) reduce pesticide risks to non-target organisms, 3) reduce potential contamination of valued, environmental resources, and 4) broaden adoption of integrated pest management (IPM) or increase effectiveness.
Advantages of Reduced-Risk Pesticides Over Conventional Pesticides

- Low impact on human health.
- Lower toxicity to non-target organisms (e.g., birds, fish, and plants).
- Less potential for groundwater contamination.
- Low use rates.
- Minimal potential for pesticide resistance.*
- Compatibility with IPM practices including cultural, physical, and/or biological.
Disadvantages of Reduced-Risk Pesticides

• Inconsistent field results.
• Limited shelf-life.
• Formulation issues.
• Economics (compared with conventional).
• Narrow range of target insect and mite pests.
Reduced-Risk or Alternative Pesticide Active Ingredients

- Bifenazate
- Chlorantraniliprole
- Dinotefuran
- Gamma-cyhalothrin
- Flonicamid
- Spiromesifen
- Spirotetramat
- Spinetoram
Reduced-Risk Insecticides

- **Caterpillars:**
  - Spinosad (Success)
  - Indoxacarb (Avaunt)
  - Tebufenozide (Confirm)
  - Methoxyfenozide (Intrepid)

- **Whiteflies:**
  - Buprofezin (Applaud)
  - Acetamiprid (Assail)
  - Pymetrozine (Fulfill)
Reduced-Risk Insecticides

- **Aphids:**
  - Acetamiprid (Assail)
  - Pymetrozine (Fulfill)
- **Leafminers:**
  - Spinosad (Success)
- **Flea Beetles:**
  - Acetamiprid (Assail)
- **Thrips:**
  - Spinosad (Success)
  - Acetamiprid (Assail)
Biopesticide

• Biopesticides are types of pesticides that are derived from natural materials such as animals, plants, bacteria, and certain minerals.

• Biopesticides are placed into three major classes:
  – Microbial pesticides
  – Plant-incorporated protectants
  – Biochemical pesticides
Biopesticide Classes

- **Microbial pesticides (or mycoinsecticides):** consist of a micro-organism as the active ingredient (e.g., bacterium, fungus, virus, or protozoa). Highly selective in activity against specific target insect pests.

- **Plant-incorporated protectants:** substances that plants produce based on genetic material that is incorporated into plants.

- **Biochemical pesticides:** naturally occurring substances that control insect pests by non-toxic mechanisms (e.g., sex pheromones).
General Characteristics of Biopesticides

- Short-residual activity.
- Sensitive to ultra-violet (sunlight) degradation and rainfall.
- Primarily active on the young (immature) stages of insect and mite pests.
- Less harmful to natural enemies (e.g., parasitoids and predators) compared to conventional pesticides.
- In general, low mammalian toxicity.
- May take longer to kill insect and/or mite pests.
Microbial Insecticides

*Bacillus thuringiensis* (Bt):

- *Bacillus thuringiensis* spp. *kurstaki* (Dipel)
- *Bacillus thuringiensis* spp. *aizawai* (XenTari)
- *Bacillus thuringiensis* spp. *tenebrionis* (Novodor)
- *Bacillus thuringiensis* spp. *israelensis* (Gnatrol)
Microbial Insecticides

Subspecies
- kurstaki
- aizawai
- tenebrionis
- israelensis

Endotoxin Specificity
- Lepidoptera
- Lepidoptera
- Coleoptera
- Diptera
Bacillus thuringiensis spp. kurstaki (Btk) Product

Biological Insecticide

DiPel® DF
Dry Flowable

Active Ingredient:
Bacillus thuringiensis, subsp. kurstaki,
strain ABTS-351, fermentation solids and solubles

Total
46%
100%

For Organic Production

KEEP OUT OF REACH OF CHILDREN
CAUTION

Precautionary Statement: HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION

Biological Insecticide

Valent BioSciences Corporation
KNOXVILLE, TENNESSEE 37934 USA

USDA Organic

EPA Reg. No. 73840-39
EPA Est. No. 30210-12-481

Hotline number:
Have the product container or label with you when calling. Treatment advice is available through your local Cooperative Extension Service, pest control agency, or by calling the Valent Hotline at 1-800-726-2774.

For more information, call 1-800-726-2774.
Understanding Microbials

- Larvae must be actively feeding on treated plant surface: stomach poison. Has to be consumed to be effective.
- Thorough coverage of all plant parts is required in order to provide uniform residues where larvae are feeding.
- Apply before economic thresholds for damage have been exceeded.
- Avoid applications during periods of cold or excessively hot temperatures.
- Susceptible to ultra-violet light degradation and rain-fast. As such, multiple applications will be required.
Caterpillars

Tobacco Budworm

Imported Cabbageworm

Beet Armyworm
How Btk Kills Caterpillars

Fig. 1. Mechanism of toxicity of Bt
Colorado Potato Beetles “In Action”
Colorado Potato Beetle Larvae
Biochemical Pesticides

• Sex pheromones: interfere with mating.

• Scented plant extracts: attract insect pests to trap.
Scented Plant Extract Traps

safe, easy... lasts all season!

APPLE MAGGOT TRAPS

THE SAFE SOLUTION

BONUS: 3 FREE LURES!
Biopesticides or Reduced-Risk Pesticides Registered For Use On Vegetables

- Vetica
- Movento
- Success
- Synapse
- Intrepid
- Radiant
- Rimon
- Ecotec
- Gemstar
Vetica®

- Company: Nichino America, Inc.
- **Active ingredients:** flubendiamide (3.8%) and buprofezin (26.4%).
- Labeled for control of caterpillars (e.g., armyworm, cabbage looper, tobacco budworm, and diamondback moth) and certain sucking insects such as mealybugs, whiteflies, and leafhoppers.
- **Contact insecticide with suppressive activity on certain insect pests.**
- Modes of action: ryanodine receptor modulator and chitin synthesis inhibitor.
- Registered for use on leafy green vegetables (e.g., cabbage), cucurbits, and fruiting vegetables (e.g., okra, eggplant, and tomato).
Movento®

- Company: Bayer CropScience LP.
- Active ingredient: spirotetramat (22.4%).
- Labeled for control of aphids and whiteflies.
- Primarily active by ingestion (stomach poison).
- Active ingredient is fully systemic, moving through the phloem and xylem to new shoots and leaves. Works best when plants are actively growing.
- Mode of action: lipid biosynthesis inhibitor.
- Registered for use on leafy vegetables (e.g., lettuce and spinach) and brassica leafy vegetables (e.g., broccoli, cabbage, and cauliflower).
• Company: Dow AgroSciences.
• Active ingredient: spinoad (22.8%). Derived from fermentation of *Saccharopolyspora spinosa*.
• Labeled for control of caterpillars including diamondback moth, cabbage looper, imported cabbage worm, and leafminers and thrips.
• Has both contact and stomach poison activity.
• Mode of action: nicotinic acetylcholine receptor agonist and GABA chloride channel activator.
• Registered for use on leafy vegetables, leaves of root and tuber vegetables, and leaves of legume vegetables.
• Company: Bayer CropScience.
• **Active ingredient**: flubendiamide (24%).
• Labeled for control of caterpillar pests including armyworm, cabbage looper, diamondback moth, imported cabbage worm, and tobacco budworm.
• **Insecticide must be ingested by insect; causing rapid cessation of feeding followed by death.**
• **Mode of action**: ryanodine receptor modulator.
• Registered for use on leafy green vegetables (e.g., cabbage), cucurbits, and fruiting vegetables (e.g., okra, eggplant, and tomato).
Intrepid® 2F

- Company: Dow AgroSciences.

- **Active ingredient:** methoxyfenozide (22.6%).

- Labeled for control of caterpillar pests including armyworm, cabbage looper, and imported cabbageworm.

- **Mode of action:** mimics action of molting hormone of larvae. After ingestion of the active ingredient, larvae undergo an incomplete and lethal premature molt.

- Registered for use on leafy green vegetables (e.g., cabbage), root and tuber vegetables, cucurbits, and fruiting vegetables (e.g., okra, eggplant, and tomato).
Radiant™ SC

- **Company:** Dow AgroSciences.
- **Active ingredient:** spinetoram (11.7%).
- **Labeled for control or suppression of foliar-feeding insect pests** such as caterpillars, Colorado potato beetle, leafminers, and thrips.
- **Minimal impact on predatory mites and beneficial insects.**
- **Spray solution pH needs to be between 5.0 and 9.0.**
- **Registered for use on leafy green vegetables** (e.g., cabbage), corn, cucurbits, fruiting vegetables (e.g., okra, eggplant, and tomato), root and tuber vegetables, and herbs.
Rimon® 0.83EC

- Company: Chemtura Corporation.
- **Active ingredient:** novaluron (9.3%).
- **Insect growth regulator:** chitin synthesis inhibitor.
- Labeled for control or suppression of caterpillars, thrips, whiteflies, lygus and stink bugs.
- Insecticide must be ingested and/or contact insect pests to be effective.
- **Insecticide has no direct effect on adults.**
- No direct effect on beneficial insects and/or predatory mites.
- Registered for use on leafy green vegetables (e.g., cabbage) and tomatoes.
Ecotec®

- **Company:** Brandt Consolidated Inc.
- **Active ingredient:** rosemary oil (10%) and peppermint oil (2%).
- **Contact insecticide/miticide** with activity on aphids, thrips, whiteflies, mites, and early stages of caterpillars (e.g., cabbage looper and armyworm).
- **Can be applied** to crops any time up to and including day of harvest.
- **Registered for use** on leafy green vegetables (e.g., cabbage), cucurbits, root and tuber vegetables, and herbs.
Gemstar® LC

• Company: Certis USA L.L.C.
• Active ingredient: polyhedral occlusion bodies of nuclear polyhedrosis virus.
• Insecticidal virus: after ingesting the virus larvae stop feeding within several days.
• Activity on corn earworm (tomato fruitworm or cotton bollworm) and tobacco budworm.
• Ideal pH of spray solution; between 6.0 and 8.0.
• Registered for use on vegetables (e.g., tomatoes, lettuce, cabbage, beans, peppers, sweet corn, cucumber, and onion).
Additional “Selective” Pesticides

• Horticultural oils.
• Potassium salts of fatty acids.
• Azadirachtin.
• Clarified hydrophobic extract of neem oil.
• Pyrethrum.
Horticultural Oil Based Pesticides

• Horticultural Oils:
  – Petroleum-based oils (Ultra-Fine Oil)
  – Plant-derived oils (GC-Mite and Golden Pest Spray Oil)
  – Fish-based oils (Organocide)
Horticultural Oils

• Products: Ultra-Fine Oil, Golden Pest Spray Oil, and Organocide.
• Types: Petroleum (or mineral), fish, and plant oils.
• Work by preventing normal exchange of gases or suffocating (block respiratory system) arthropod pests.
• Kill most life stages (egg, young, and adult).
• Primarily active on soft-bodied arthropods such as aphids, spider mites, scales, thrips, whiteflies, mealybugs, and psyllids.
• Minimal risk of resistance developing.
• Contact only so thorough coverage is essential; however, may be harmful to plants if applied “too often” or if applied during conditions of high humidity.
• May be directly harmful to natural enemies.
Potassium Salts of Fatty Acids

- **Product**: M-Pede.
- **Kill target insect (and mite) pests by primarily disrupting the cuticle resulting in desiccation.**
- **Contact only so thorough coverage is essential; short-residual activity.**
- **Primarily effective against soft-bodied arthropods such as aphids, whiteflies, spider mites, and mealybugs.**
- **Water hardness (calcium and magnesium) may reduce effectiveness.**
- **Harmful (=phytotoxic) to plants if used “too often.”**
- **In general, not indirectly toxic to natural enemies.**
Potassium Salts of Fatty Acids Product
Azadirachtin

- **Products:** Azatrol and Neemix.
- **Derived from the neem tree, *Azadirachta indica.***
- **Multiple modes of action:** insect growth regulator, antifeedant, sterilant, and oviposition inhibitor.
- **Primarily active on caterpillars; more so than other arthropod pests.**
- **Multiple applications are typically required.**
- **Susceptible to ultra-violet light (sunlight) degradation and rainfall.**
- **More effective on young stages than eggs and adults.**
- **Works best under warm temperatures (>70°F).**
Neem Oil

• Products: Triact and Organica (neem oil and soap).
• Active ingredient: clarified hydrophobic extract of neem oil.
• Works by suffocating (blocking breathing pores) arthropod pests.
• Primarily active on soft-bodied arthropod pests such as aphids, spider mites, whiteflies, mealybugs, and scales.
• Harmful to plants if used “too often.”
• May directly affect natural enemies.
Clarified Hydrophobic Extract of Neem Oil Product
Pyrethrum

- Products: Pyganic.
- **Pyrethrum**=generic name; **pyrethrins**=six constituent compounds derived from chrysanthemum flowers.
- Contact only with short-residual activity.
- Highly toxic to bees.
- Susceptible to ultra-violet light (sunlight) degradation.
- May be active on a broad range of arthropod pests including true bugs, caterpillars, flies, aphids, and whiteflies.
- Derived from **Tanacetum** (formally **Chrysanthemum**)
  - **cinerariaefolium**, **T. coccineum**, and **T. marshalli**
  (Kenya, Africa, and Ecuador).
Pyrethrum-based Product

PyGanic

Contains pyrethrum—a botanical insecticide derived from chrysanthemums
Provides rapid knockdown and kill of plant pests
For use on growing crops and ornamentals
Can be used on day of harvest
Controls key livestock pests
Controls more than 100 insects

ACTIVE INGREDIENT:
Pyrethrins 1.0%
Pyrethrum 0.0%

OTHER INGREDIENTS:
Paraquat 38.50%
Diquat 200.0%

KEEP OUT OF REACH OF CHILDREN
CAUTION PRECAUCION
Si usted no entiende la etiqueta, busque a alguien para que le lea y explique lo que usted no entiende.
(If you do not understand the label, find someone to explain it to you in detail.)
SEE BOOKLET FOR FIRST AID INSTRUCTIONS

Manufactured by: MGIC
McLaughlin Corkley King Co.
8510 7th Avenue North
Minneapolis, MN 55427

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Summary

- Reduced-risk pesticides are a class of compounds that pose a low health risk to humans and the environment. Considered “alternative” materials to organophosphosphate-based insecticides.

- Biopesticides are those that are derived from natural materials such as animals, plants, bacteria, and certain minerals. Three major classes: microbial, plant-incorporated protectants, and biochemicals.

- It is important to understand the characteristics of reduced-risk pesticides, biopesticides, and other pesticides to determine the benefits and limitations associated with each pesticide.
Contact Information

Raymond A. Cloyd
Kansas State University
Department of Entomology
Manhattan, KS 66506-4004
Phone: 785-532-4750
Email: rcloyd@ksu.edu
Thank You For Your Attention!

I Hope You All Learned Something!
Questions or What’s Bugging You?