

Integrated Pest Management

Patrick Trail
Research & Technical Associate
ECHO Asia Impact Center
ptrail@echonet.org

Today's Workshop

Two Case Studies: Citrus Greening and Sugarcane White Grub

An Overview of Integrated Pest Management

A Rapid Guide to Pest Identification

A Brief Introduction of Several 'Appropriate' Pesticides




There is good news, bad news, and good news

Good news – 99% of insects are beneficial or benign

Bad news – There are over 10 million insects (100,000 are pests)

Good news – Implementing IPM can help manage your pests effectively

A solid blue horizontal bar spanning the width of the slide, located at the bottom.

Sugar Cane White Grub – Bali, Indonesia (*Lepidiota stigma*)

- Consumes roots of banana, cassava, sweet potato, and several vegetable crops
- No natural predators



Citrus Greening in Florida

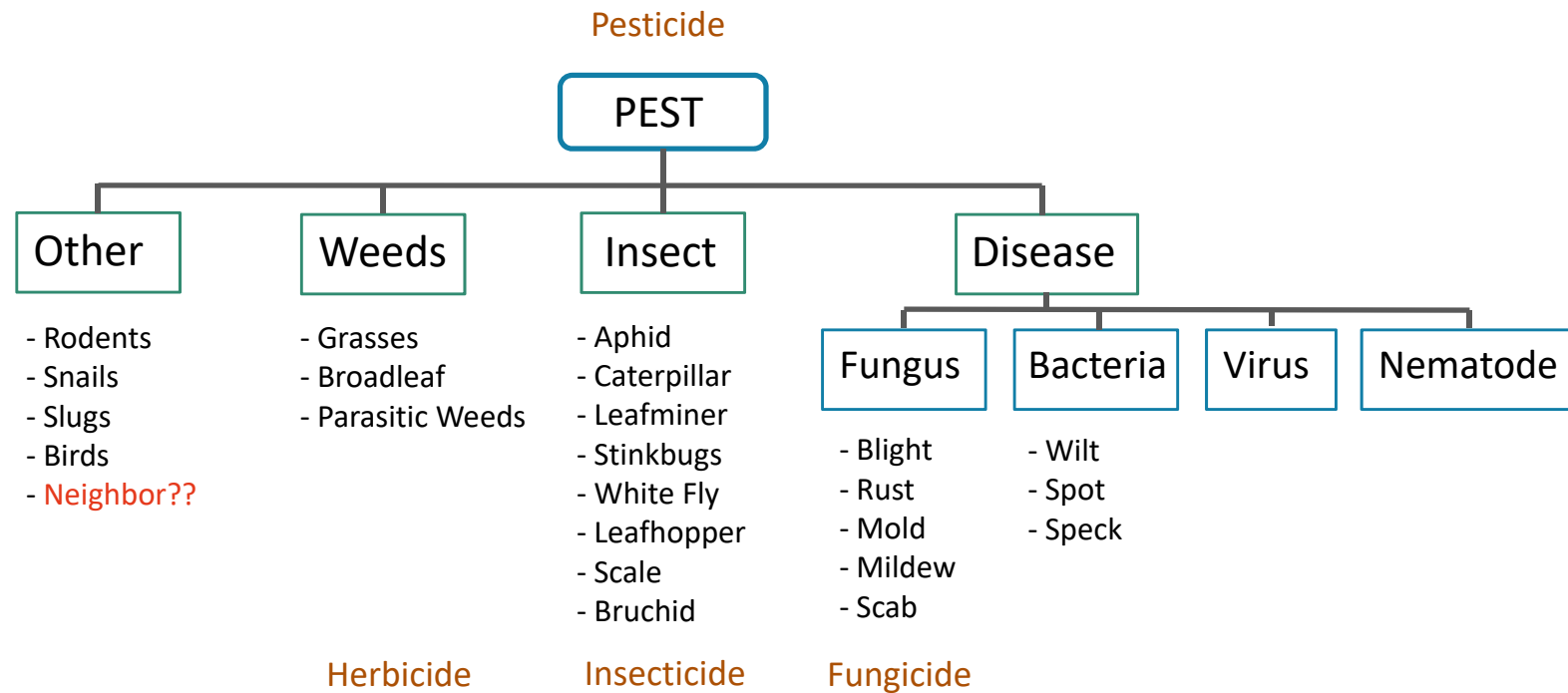
- Caused by the Bacteria *Candidatus liberibacter*
- Bacteria is transferred by vector *Diaphorina citri* (Asian citrus psyllid)



What is the definition of a pest?

“Any organism that negatively impacts the production and profitability of agricultural products”

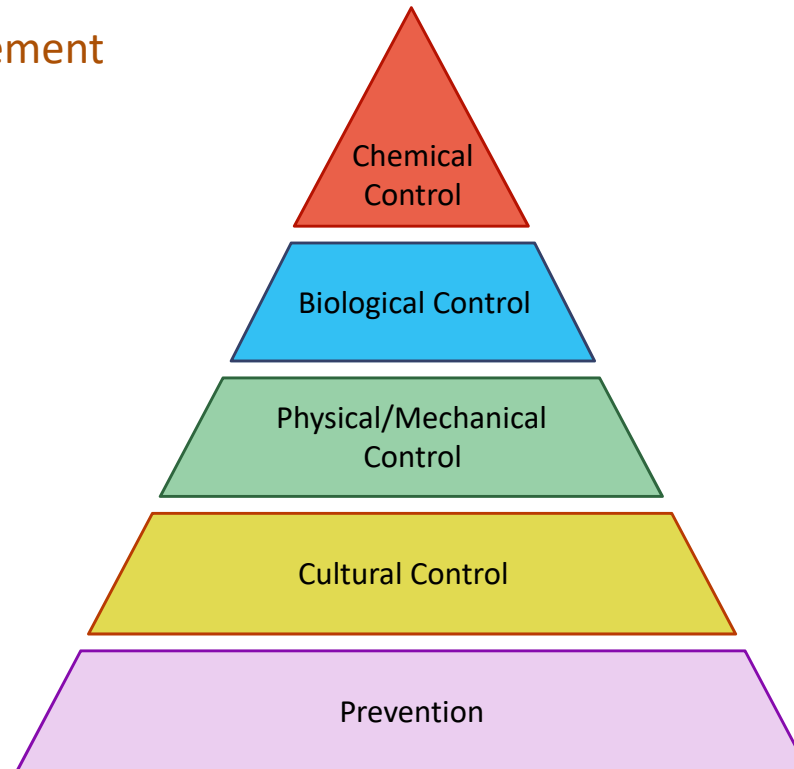
Who is the pest?



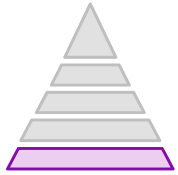
What is Integrated Pest Management ?

“An ecological approach to pest management that understands the causes of outbreaks, how to manipulate ecosystems and how to evaluate thresholds to determine if control is needed”

The Integrated Pest Management Approach



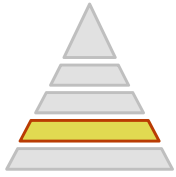
Knowing injury levels and
action thresholds is also very
important



Prevention

- Improved varieties (pest & disease resistance; grafting)
- Soil Fertility/Adequate Nutrients
- Good (disease free) seed
- Timing of planting and harvesting

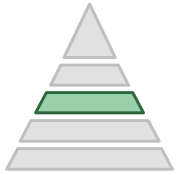




Cultural Controls

- Farm sanitation practices
- Remove diseased and sick plants
- Prevent weeds from going to seed
- Cleaning equipment after working with infected crops
- Breaking pest cycles through Crop Rotation
- Removing hosts plants





Physical/Mechanical Controls

- Removing killing pests by hand
- Cultivation
- Introducing pest traps (sticky traps, pheromone traps, nets, etc...)
- Irrigation practices
- Row covers, nets, plastic, reflective surfaces, etc...
- Mulching





Biological Controls

- Using parasitic wasps to control aphids
- Beetles for controlling air potato
- Parasitic wasp to control papaya mealy bug





Chemical Control

- Organic vs. Conventional
- Natural vs. Synthetic
- Broad Spectrum vs. Targeted
- Preventative vs. Curative
- Resistance

PESTICIDE	NON-TOXIC	LOW TOXICITY	HIGHLY TOXIC
Insecticides/Repellants/Pest Barriers			
<i>Bacillus thuringiensis</i> (Bt)	Green		
<i>Beauveria bassiana</i>			Red
Boric Acid		Orange	
<i>Cydia pomonella granulosis</i>	Green		
Diatomaceous Earth			Red
Garlic	Green		
Insecticidal Soap ^a			Red
Kaolin Clay	Green		
Limonene ^a		Orange	
Neem ^a		Orange	
Horticultural Oil ^{a,b}			Red
Pyrethrins ^c			Red
Rotenone ^c			Red
Ryania/Ryanodine		Orange	
Sabadilla ^c			Red
Spinosad			Red
Herbicides/Plant Growth Regulators/Adjuvants			
Adjuvants		Orange	
Corn Gluten	Green		
Gibberellic Acid	Green		
Horticultural Vinegar		Orange	
Fungicides/Bactericides			
Copper		Orange	
Copper Sulfate			Red
Lime Sulfur ^a , Sulfur ^{c,d}		Orange	

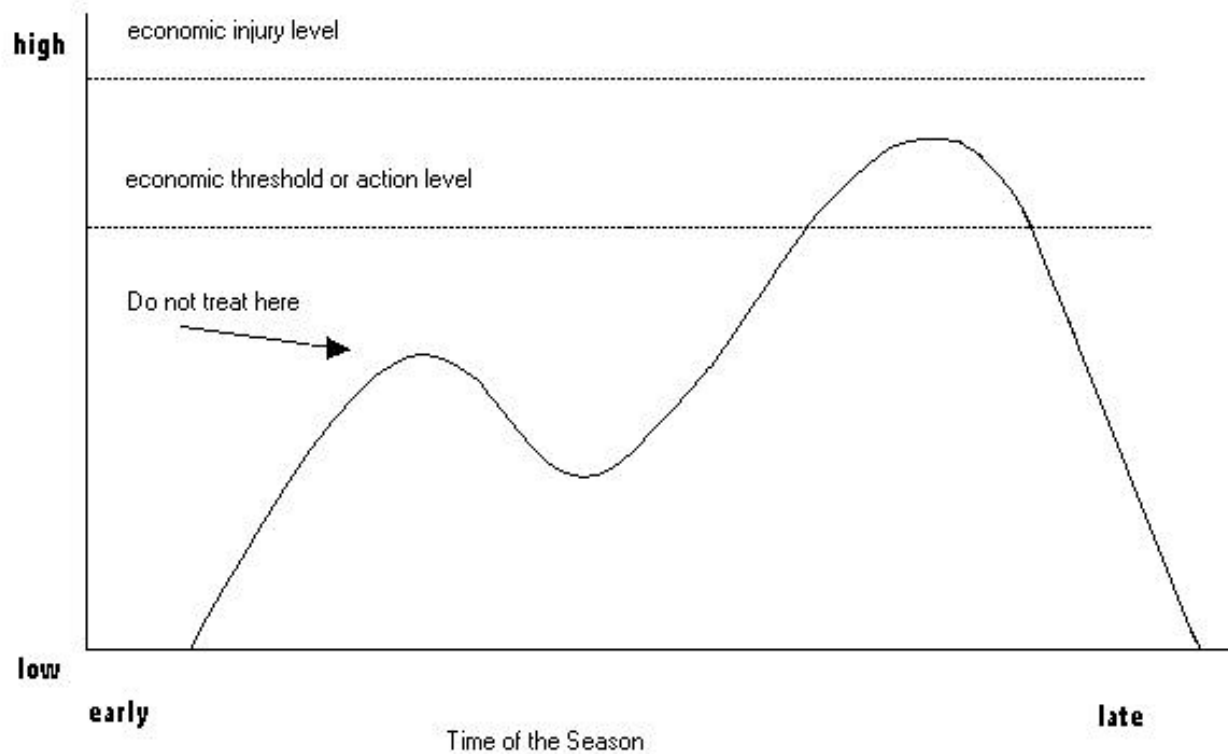
^aLow risk to bees if applied at night when bees are inactive

^bSome horticultural oils (such as formulations with thyme or rosemary oil) primarily sold as fungicides.

^cRepellent >1day. In greenhouse setting, bees should be removed prior to spray and not replaced before 1.5 days after spray.

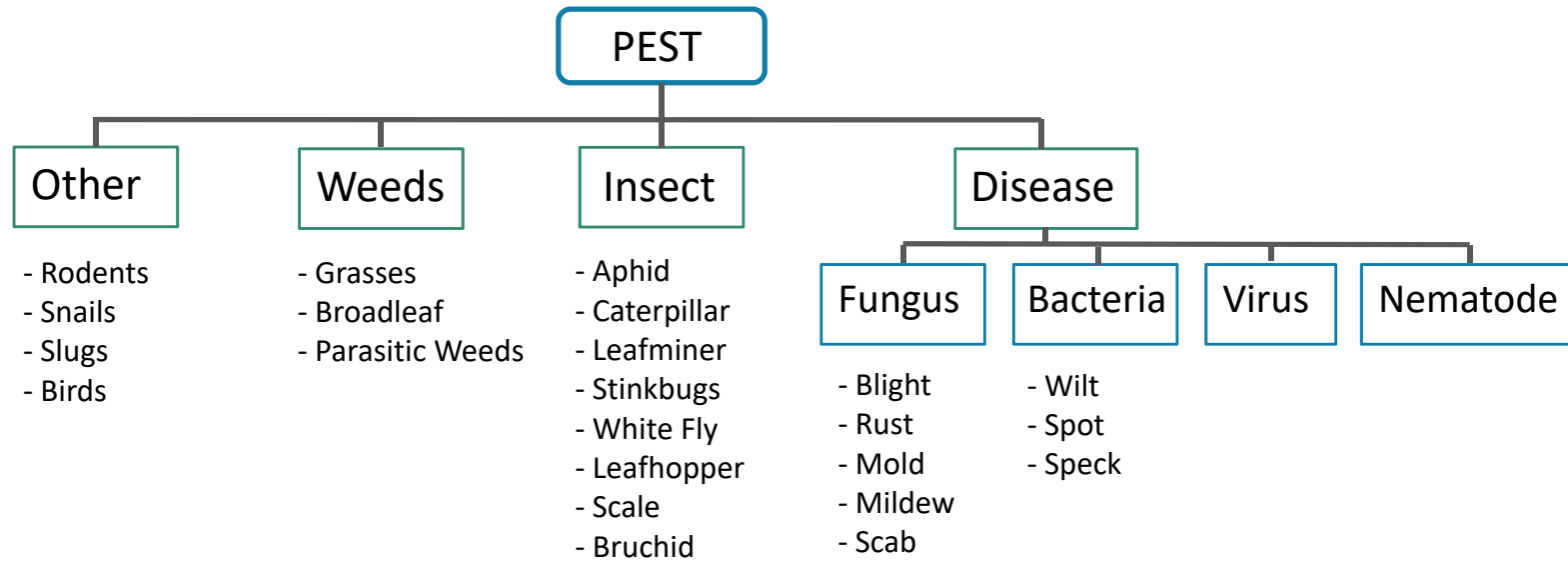
^dLong residual toxicity (1-7 days).

Scouting, Monitoring, and Knowing **WHEN** to treat?



<http://www.umaine.edu/umext/potatoprogram/Fact%20Sheets/scouting.pdf>

Scouting, Monitoring, and Knowing **WHAT** to treat?



PEST AND DISEASE DIAGNOSIS 101

Insect Pests

Chewing

- Caterpillars, grasshoppers,
- leafminer, beetle



Insect Pests

Rasping

- Slugs
- Snails
- thrips



Insect Pests

Piercing/Sucking Insects

- Aphids, white fly, mealy bugs, scale
- Stink bugs, Leafhopper



Diseases

Fungi

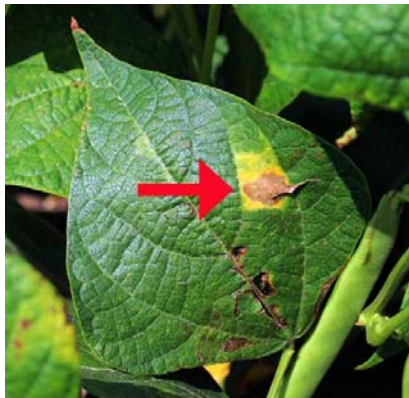
- Cause 85% of all plant diseases
- Survive without a host
- Move plant to plant by wind, rain, seed & human activity
- Grows at night, concentric circles
- Black or brown dots are fruiting bodies



Diseases

Bacteria

- Single celled, microscopic
- Usually requires a host to survive
- Enters plant through wounds and natural openings
- Move plant to plant by water (irrigation, rain, dew), seed, human activity and insects
- Yellow Halo or greasy looking



Diseases

Virus

- Microscopic
- Require a host to reproduce
- Move plant to plant by insects, mites, nematodes, fungi and human activity
- Problematic for vegetatively propagated material



A FEW APPROPRIATE LEVEL OPTIONS

Some Appropriate Pesticide Options for the Smallholder Farm

Insecticides

- Soap
- Oil
- Neem
- Chili Pepper
- Garlic
- Tobacco
- Pyrethrum
- Bt (*Bacillus Thuringiensis*)
- *Beauvaria bassiana*
- Diatomaceous earth
- Kaolin Clay

Fungicides

- Tricoderma
- Horticultural Oils
- Neem
- Sulfur

Insecticidal Soap

- In low concentrations (just a pinch or a few drops) it reduces surface tension, makes other pesticides more effective.
- 0.5% concentration kills aphids, small caterpillars
- 0.8% concentration kills larger caterpillars, beetles
- For a 20 L sprayer:
 - 0.8%=150 ml, or 1 ½ tea glasses, or 3 men's handfuls, or 4 ½ woman's handfuls
 - 0.5%=100 ml, or 1 tea glass, or 2 men's handfuls, or 3 woman's handfuls

Oils

- Acts as a deterrent
- Can protect stored grain (for eating, not for seed, interferes with germination)
- 1 L oil + 100ml soap + 15 L water
- Don't spray early in the day!

Neem (Azadirachta indica)

- Contains multiple insecticidal compounds, most prominently Azadirachtin. Also fungicidal and nematocidal.
- Insecticide found in all parts of the tree, but is strongest in the seeds
- Acts as a deterrent, and inhibits viable reproduction
- Effective on a wide range of insects
- Also used to protect stored grain and beans



Neem (Azadirachta indica)

- Neem Oil Spray:
 - Crush 2 handfuls of seeds
 - Soak for 15 minutes in hot water, or overnight in cold water
 - Mix into sprayer with a little soap, and 9 L of water for every liter of neem mixture.
- Neem Leaf Spray:
 - Bruise 1 kg of leaves
 - Same process as above
- Broken down by sunlight, best applied in the evening

Chili Pepper (Capsicum Frutescens)

- Both repellent and insecticidal
- Can burn leaves, test your spray on a few plants before you do them all.
- Chili Spray:
 - Grind 2 handfuls of chillies
 - Soak in 1 L of water for a day
 - Add 5 L of water and a little soap

Garlic

- Anti-feedant, insecticidal, bactericidal, fungicidal, nematocidal, repellant
- Expensive compared to other treatments
- Can be combined with other plants like Chili and Neem
- Garlic spray:
 - Crush 1 garlic bulb
 - Add 1 L of water and a little soap
 - Use immediately

Tobacco

- One of the oldest insecticides. Used for more than a hundred years. Intercropped with maize in some areas.
- Powder form can be used to protect seed (but not for eating)
- “Cigarette Water” Spray:
 - Soak 1 cigarette, or 10-15 leaves in hot water for 10 minutes, or cold water overnight
 - Filter into tank
 - Add 10 L of water and a little soap

Pyrethrum (Chrysanthemum cinerariaefolium)

- Daisy-like Chrysanthemum. Contains nerve poison in its open flowers.
- Harmless to bees, animals, birds and people. But may have negative effects on other beneficials like parasitic wasps.
- Pick open flowers and dry in the shade, then grind to powder and store away from sunlight. Dust can be used by itself, mixed with talc or sand, or soaked into a spray.



Pyrethrum (Chrysanthemum cinerariaefolium)

- Pyrethrum spray:
 - Mix 20 gm Pyrethrum powder with 10 L of water
 - Stir well, use immediately. Best in the evening.
- Use kerosene instead of water for a more long-lasting effect:
 - Steep 500 gm of pyrethrum flowers in 4 L of kerosene for half a day.
 - Strain and use

TRICHODERMA AND BEAUVERIA

What are Biocontrol Agents?

Trichoderma- beneficial fungal species that can be used as a soil drench or plant sprayed fungicide

Beauveria- beneficial fungal species that can be used as a plant sprayed insecticide

Supplies



Rice cooker and rice

Large spoon

Trichoderma or *Beauveria* powder

Plastic bags

Rubber bands

Needle

Process

Mix 3 parts rice (sorghum can also be used)
with 2 parts water

Set to cook



Process

Clean your work station with soap and then alcohol



Process



Scoop rice into new, clear plastic bags

3-4 scoops per bag

Process

Fold bags over to avoid contamination of foreign spores

Allow rice to cool enough so it is not too hot to hold against skin



Process

When rice has cooled, add ½ teaspoon
Trichoderma or *Beauveria* powder

Seal bag with a rubber band and mix powder
in with rice



Two ways to seal bags:



Simply using rubber bands



Using pieces of PVC and rags

Process



Poke 10-15 holes in the top third of the bag with a clean needle

Process

Place bags into a clean, disinfected place indoors at room temperature

Do not store in a dark place with no artificial or natural light

After 2 days, mix the rice again, and pat it down

Process

After 7 days, the fungi should take over the whole bag

It is now usable, but can live in the bag for 3-4 weeks longer

What to look for

- Healthy ***Trichoderma***: should have a sweet coconut odor and is most often dark green, but can be white or yellow
- Healthy ***Beauveria*** is scentless and should be white



Using the Biocontrols

Dilute 1kg of inoculated rice into 200L of water

Trichoderma can be used as a soil drench, added to compost, or sprayed onto plant leaves and stems for fungal pathogen control

Beauveria can be used as a insecticide sprayed onto plant leaves and stems

One word of caution- *Beauveria* is not selected, so can kill beneficial and pest insects

Helpful IPM Resources

Seminis Crop Disease Guides

Diseases of Tomato Plants:

[file:///C:/Users/Admin/Documents/Technical%20Resources/Disease%20Diagnosis%20Guides/SEM-12094 TomatoDiseases x1.pdf](file:///C:/Users/Admin/Documents/Technical%20Resources/Disease%20Diagnosis%20Guides/SEM-12094%20TomatoDiseases%20x1.pdf)

Diseases of Crucifers:

[file:///C:/Users/Admin/Documents/Technical%20Resources/Disease%20Diagnosis%20Guides/SEM-12093 Crucifer Disease Guide 072313.pdf](file:///C:/Users/Admin/Documents/Technical%20Resources/Disease%20Diagnosis%20Guides/SEM-12093%20Crucifer%20Disease%20Guide%20072313.pdf)

Diseases of Cucurbits:

<file:///C:/Users/Admin/Documents/Technical%20Resources/Disease%20Diagnosis%20Guides/Cucurbit-Disease-Guide-Final-012015.pdf>

Diseases of Onions:

<file:///C:/Users/Admin/Documents/Technical%20Resources/Disease%20Diagnosis%20Guides/Onion-Disease-Guide.pdf>